

**ENVIRONMENTAL LITERACY AND SUSTAINABILITY VALUES: A  
CONTENT ANALYSIS OF NATIONAL EE FRAMEWORKS AND STATE  
STANDARDS THROUGH THE LENS OF THE EARTH CHARTER**

A Dissertation

by

JULIE ANNETTE SINGLETON

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2011

Major Subject: Curriculum and Instruction

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## **ABSTRACT**

Environmental Literacy and Sustainability Values: A Content Analysis of National EE Frameworks and State Standards through the Lens of the Earth Charter.

(December 2011)

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Mainstream scientists have grave concerns regarding unsustainable lifestyles in a world with finite resources. Lack of environmental literacy, sustainability values, connectedness to nature and environmental education as a core subject need to be addressed through environmental education. This mixed-methods content analysis examines and compares five state environmental education standards, national environmental education guidelines and the Earth Charter for inclusion of sustainability values.

The Earth Charter states the international consensus principles of sustainability values. Data were generated through traditional quantitative coding, computer text analysis and the creation of document profiles through qualitative methods. Triangulation of the findings from these three methods showed that state standards and national guidelines adequately address ecological integrity principles, but not environmental justice principles associated with flourishing, sustainable communities. The North American Environmental Education guidelines and Wisconsin and Colorado

state standards do include reflection on environmental values, issue analysis and environmental agency objectives. The Advanced Placement Course Description, New York and Texas standards are less concerned with ethics or values and more concerned with an ecological, scientific approach to environmental education. With the current political climate, international sustainability values as expressed by the Earth Charter would not pass through policy gatekeepers. In a standards-driven climate, standards are needed to open the gate for inclusion of environmental education in school curricula.

## **DEDICATION**

To my life partner, Patricia Bentley. Her sacrifice and support allowed me to fulfill my potential and follow my passion.

To my Mother, Nancy Adams, for her material and financial support.

To my step-father, James R. Adams. He taught me to persevere and live by my principles. I know he would have been proud of this accomplishment.

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Thanks also to my classmates, professors and colleagues who expanded my knowledge and understanding of the complex nature of schooling, education and the development of human potential. In addition, I want to offer my thanks to the National Science Foundation and the Department of Teaching, Learning and Culture for helping to fund my graduate program and allowing me opportunities to expand my teaching repertoire.

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## CHAPTER I

### INTRODUCTION

#### **Background**

Environmental literacy and education for sustainability are becoming increasingly important topics in the current climate of environmental concern. The Union of Concerned Scientists (1,600 scientists from 70 countries that included over 100 Nobel laureates and 60 U.S. National Medal of Science winners) signed a warning regarding global climate change and widespread environmental damage and habitat destruction caused by human consumptive habits and other ecologically unsustainable behaviors (Union of Concerned Scientists, 1992; 1997). Their claims are based on decades of empirical evidence and call for fundamental lifestyle changes of the developed world. A brief document signed by the National Science Academies' of Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, United States and the United Kingdom affirm that climate change is real and preparations should be made for the consequences of climate change (Joint Science Academies, 2005). Resource demands of a growing population will stress limited supplies of fresh water, arable land, fossil fuels and decrease biodiversity (Edelson, 2007). Changes are needed to avoid collapse of critical ecological systems and decline of environmental quality that could lead to social and economic upheaval (Union of Concerned Scientists, 1992; 1997).

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This dissertation follows the style of Journal of Research in Science Teaching.

Rachael Carson's (1962) *Silent Spring* has often been credited as the catalyst for the environmental movement that began in the 1960's (Miles, 1987; Stevenson, 2007). The first printing of the *Journal of Environmental Education* occurred in 1969 when William B. Stapp coined the term and parameters of environmental education. In April of 1970, the United States celebrated its first Earth Day and by the end of the year, the Environmental Protection Agency was created by Congress. The Belgrade Charter: A Global Framework for Environmental Education (UNESCO, 1972) and The Tbilisi Declaration (UNESCO, 1977) issued guiding principles for international environmental education during the 1970's. The Tbilisi objectives include awareness, knowledge, affect, skills and participation (UNESCO, 1977). In 1983 the United Nations formed the Brundtland Commission to establish policies for sustainable development. In 1990, Congress passed the National Environmental Education Act with the goal of increasing environmental literacy among citizens; but environmental education has not achieved a core subject status in the schools (Coyle, 2005). Environmental education has been a part of the curriculum for decades, yet dominant environmental paradigms, which tend to be anthropocentric or egocentric and unsustainable, seem to persist (Kushmerick, Young, & Stein, 2007; Stevenson, 2007). The fact that citizens of the United States have the largest per capita consumption levels or ecological footprint in the world is a reflection of our country's general lack of commitment to sustainable communities (Jorgenson, 2003; Mostafa, 2010).

Disinger and Roth (1992) define environmental literacy as the capacity to perceive and interpret the relative health of environmental systems and take action to

maintain and restore those systems. The Tbilisi Declaration (UNESCO, 1977) defines the aim of environmental education as understanding the complex nature of the environment and participating in a responsible and effective way to anticipate and solve environmental problems. Yet a report by the National Environmental Education and Training Foundation has found that our citizenry is both uninformed and misinformed (Coyle, 2005). The lack of environmental literacy in the United States is evidenced by misunderstanding of our citizenship in the biotic community, disbelief in our dependence on healthy ecosystems for our basic survival needs and a lack of ethical sense toward habitat (Leopold, 1949; Orr, 1992; Pyle, 2008). Without basic knowledge, citizens are not aware of environmental problems and cannot even begin to adequately address them.

There is also the disturbing phenomenon that Louv (2005) describes as “nature-deficit disorder.” For many reasons, children are spending less time in the outdoors and are more connected to electronics than the natural environment (Louv, 2005). The unprecedented lack of connection with the outdoor natural world can affect basic knowledge, awareness and the value one places on the environment (Coyle, 2005). Value discernment requires an interaction between the concrete word and the perceiver (White, 2009). The implications for environmental literacy are unknown, but many believe a personal relationship with nature is an essential element of caring about the environment (Chawla, 2006; Mayer & Frantz, 2004; Schultz, Shriver, Tabanico, & Kharzian, 2004). Values are influenced by feelings, and an area of emergent research is exploring affective influences such as connectedness to nature on pro-environmental

behaviors (Kals, Schumacher, & Montada, 1999; Mayer & Frantz, 2004; Stern 2000). Beliefs that individuals hold about the relationship between self and nature are a core element of environmental value and behavior (Schultz et al., 2004). If environmental literacy, sustainability and green behaviors had greater value in our society, these literal facts of life on planet Earth would become central to our lifestyles and what we teach in our schools (Orr, 1992, Stevenson, 2007).

### **Conceptual Foundation**

Ecological sustainability as defined by the Brundtland Commission means to meet the resource needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment & Development, 1987). Non-renewable resources are finite and incompatible with unlimited resource consumption. Because Western society is lulled by comfort, convenience and the arrogant belief that technological solutions can fully address issues of overreaching carrying capacity, there is a refusal to face the social-cultural root of the problem that lies in how the environment is understood, perceived and valued by individuals and societies (Kushmerick, Young, & Stein, 2007). Most people are out of touch with the daily ways in which lifestyle choices affect the ecosystem and, for that matter, where it all comes from and where it all goes when we are done with it (Coyle, 2005). Because the majority of people are far removed from life-sustaining systems, the importance of these systems is given little thought (Orr, 1992). If people were more aware of their local bioregion and how the ecosystem utterly supports us perhaps they would be more willing to make efforts to make lifestyle changes (Pyle, 2008). Some

believe that fostering the development of ecocentric values through education is central to changing behaviors that affect future sustainability (Andrzejewski, Baltodano, & Symcox, 2009; Bowers, 1995; Greenwood, Manteaw, & Smith, 2009; Orr, 1992). Pugh (2002) hypothesizes that values are difficult to affect and to measure, but emphasizes that a change in values is essential for transformative learning. Evidence of a link between environmental education and pro-environmental values is not consistent and research suggests that improving environmental values is not likely unless there is an explicit focus on these issues (Rickinson, Dillion, Teamy, Morris, Choi, Sanders, & Benefield, 2004). Empowering students to find personal meaning and to discover their own values related to the environment will extend beyond the classroom to action competence in pro-environmental behaviors (Payne, 2010). Environmental education offers a social vision of transformative education because it is learner-centered and begins with the immediate world of the learner (Edelson, 2007; Gruenewald, 2004). Issues of ethics, values and eco-justice are central to this transformation (Greenwood, Manteaw, & Smith, 2009).

Democratic values are essential to eco-justice, and the challenge for environmental educators concerned with eco-justice and ethics is to allow students to develop values and opinions without indoctrination (Ostman, 2010). Sustainability goals may not be expressive of current politics and policies in the Western world; therefore, environmental education requires flexible process-based approaches rather than product-based performance encouraged by high stakes testing and standards-driven practices (Gruenewald, 2004; Stevenson, 2007). Critical, independent thinking with an emphasis

on evaluation of evidence is the goal of scientific literacy that has been proposed by the American Association for the Advancement of Science (1990) and research on best instructional practices for science educators (National Research Council, 2007). It is imperative that children are taught *how* to think and not *what* to think (AAAS, 1990). Inclusion of these student-centered approaches, which are part of current educational reform efforts, must accompany an infusion of ecological ethics in environmental education for sustainability (Stevenson, 2007). Because the consideration of personal values and student-centered instructional reforms challenge traditional educational norms, sustainability education is transformative in nature and has transformative potential for students, teachers, educational practices, communities and the non-sustainable ecological paradigm of Western society (Gruenewald, 2004; Lange, 2004; Leigh, 2005; Sipos, Battisti, & Grimm, 2008).

Transformation goes beyond epistemological processes of a change of worldview to an ontological process of a change in being in the world (Lange, 2004). Much educational research is focused on cognitive gains, pedagogical transmission, assessment and epistemological conceptions or misconceptions (Wong, 2007). Research is limited in regard to the more aesthetic qualities of human learning experiences, such as interest, inspiration and values (Brooks, 2004; Payne, 2010; Wong, 2007). Environmental education is unique in that academic, cognitive outcomes are “not necessarily the main game in environmental education” (Ladwig, 2010, p. 127) and many environmental educators strive to include a larger cultural landscape that includes humanistic development and “messy social and political issues” (Gruenewald, 2004, p. 84). Still, as



environmental educators strive to be included in general education curriculum, they may adopt practices that do not reflect the larger purposes of environmental education goals expressed at international conferences (Gruenewald, 2004). Transforming the present arrangement of global economic and political power will disturb the current pattern of resource use, and most educators do not seek to upset the existing social and economic order (Stevenson, 2007).

To a great extent, environmental education has been forced to conform to norms and routines of schools, and its compliance has muted its potential as a transformative educational discourse (Gruenewald, 2004). In an effort to join the conventions of traditional education, the North American Association for Environmental Education, NAAEE, (2004) created a standards document, *Excellence in Environmental Education: Guidelines for Learning (K-12)*. This document adapts the language, concepts and format of conventional standards and may serve to legitimize rather than challenge and transform educational practices that are problematic to sustainability and eco-justice (Gruenewald, 2004). It should be noted that the NAAEE standards are not binding unless individual states choose to adopt them.

As a matter of fact, there are many national organizations that address environmental science standards, guidelines or frameworks such as the National Academy of Science, The American Association for the Advancement of Science, the Advanced Placement College Board and the National Research Council. There has been a movement toward national standards that began with *A Nation at Risk* in 1983 and has continued until the present as evidenced by the Race to the Top requirement of adopting

the national language arts and mathematics standards to compete for federal funds (Denning, 1983; National Academy of Sciences, 2010; Simmons, 2005). The newest science standards anticipated in the summer of 2011, Next Generation Science Standards, have involved a national effort to identify core ideas, cross-cutting content, sound models of student learning and consensus with international standards. The Next Generation Science Standards do not have a dedicated environmental science section; these objectives will be embedded in the life and earth science sections.

The Earth Charter (2000) is part of an international discourse on environmental education that goes beyond ecological concepts to include environmental justice issues related to health, race, economics, technology, globalization and ethical responsibility (Greenwood et al., 2009; Kushmerick, et al., 2007). The Earth Charter is an international consensus document that contains the guidelines for sustainability that provide the starting point and global context for examination of inclusion of values and social justice in environmental education instruction (Greenwood et al., 2009; Gruenewald, 2004). It was first conceived in 1990 when Freire and his colleagues began organizing an eco-pedagogy movement that would lead to the first Earth Summit in Rio de Janeiro, Brazil. The goal of the movement was to encourage emancipatory action through the re-education of planetary citizens to become builders of a sustainable society (Kahn, 2008). It was decided that a systematic statement was needed that would formulate the ethical and ecological concerns of environmental education (Kahn, 2008). Freire passed away before this document was completed, but in 1994, Strong, former undersecretary general of the United Nations and Gorbachev, former head of state of the USSR, along with the

Dutch government renewed interest in the Earth Charter. The Brundtland Commission was formed to develop this framework for sustainable education. The Earth Charter was released in 2000 at UNESCO headquarters in Paris. This bold educational reformulation contains sixteen principles that are categorized into four sub principles: respect and care for the community of life; ecological integrity; social and economic justice; and democracy, nonviolence and peace. (The Earth Charter Principles are found in Appendix A.) The inclusion of social and economic justice is evidence that the roots of the Earth Charter are founded in critical theory and the emancipatory work of Freire. He claimed that lack of caring for the planet and each other contribute to planetary crisis (Kahn, 2008).

Endorsed by UNESCO, the World Conservation Union and the U.S. Conference of Mayors, there are ninety-seven affiliated organizations in fifty-eight countries, such as Australia, Brazil, Canada, Germany, Mexico, New Delhi, Norway and Russia, which have committed to adopt and implement the Earth Charter (Earth Charter, 2011). In 2005, UNESCO called for a decade of education for sustainability and claimed that people need to learn to live sustainably to reduce future effects of current environmental and social problems (UNESCO, 2005). Unfortunately, the international discourse of environmental education seems to be in contrast with the U.S. Department of Education and individual state education policies; they have been silent about the United Nations Decade of Education for Sustainable Development (Greenwood et al., 2009). Sustainability is in conflict with the status quo that continues the growth of militarism, transnational development and a consumer driven economy (Kahn, 2008). The Earth

Charter may not represent the values of all Americans and the United States has not endorsed the Earth Charter.

The Earth Charter is a declaration of fundamental principles and values for building a just, sustainable, and peaceful global society in the 21st century (Mukherjee, 2005). This revolutionary document that includes issues of social justice, democracy and ecological integrity claims that sustainable communities are not viable without equity and ethical responsibility to the environment and to one another (Kahn, 2008). Although including values in the classroom is contested over concerns of *whose values* or *which values* are being promoted, this should be less of a concern because the values represented by the Earth Charter are core values that respect human dignity and affirm life (Earth Charter, 2009). The claim is that legislative and technological attempts to address environmental issues will not work without addressing the roots of the problem related to the ethical values of sustainability and a sense of global responsibility (Earth Charter, 2009; Kushmerick, et al., 2007). These values underlie the decisions that must find balance between short-term interests and the long-term health of the ecosystem, as well as the needs of future generations (Earth Charter, 2009).

A democratic society needs an informed citizenry to deal with increasingly challenging environmental problems. The report card on the environmental literacy of the American public indicates they have only a superficial knowledge and awareness of basic ecological facts and environmental issues (Coyle, 2005). The public is more likely to believe environmental myths than environmental facts (Coyle, 2005). As fewer Americans interact with nature, the experiential knowledge of nature and environment

will continually diminish. School programs that involve students in outdoor environmental activities can address the issue of nature-deficit disorder giving students first-hand knowledge of local environments (Louv, 2005). Educational reform efforts that stress the environment as an integrating context, place-based programs, restoration projects and local environmental investigations could attend to the problems of lack of environmental literacy, nature-deficit disorder and improving scores on state accountability assessments (Children and Nature Network, 2008; Hoody and Lieberman, 1998; Rickinson, et al., 2004; Sobel, 2004). Unfortunately, in many states, environmental science is not offered as a specific course and environmental concepts are an add-on to life and earth science courses.

### **Rationale and Purpose**

Addressing the lack of environmental literacy, lack of experience in nature, lack of depth of environmental education and a lack of environmental values is a difficult task. An initial step toward reform is to evaluate existing environmental education documents, such as standards, for relatedness to the international consensus guidelines of the Earth Charter (Greenwood et al., 2009). Indeed, the Earth Charter states that it can be used to assess curriculum to ensure students are prepared for sustainability issues (Earth Charter, 2000). Standards are the reflections of educational policies and cultural indicators generated from policy documents constitute reliable data (Bazerman, 2006; Weber, 1990). Generally, content analysis is applied in educational research to examine textbooks, but standards are foundational for textbooks, curricula and assessments. Knowing the content of standards is a key to monitoring the implementation and effects

of educational reform (Porter, 2002). Yet no studies could be found that have empirically confirmed the extent of inclusion of the Earth Charter international educational guidelines in standards (Kushmerick, et al., 2007). The purpose of this study is to conduct a content analysis of national and state environmental standards for the inclusion of the international sustainability values stated by the Earth Charter, which is designed to serve as a reference document for an educational framework, as well as development of policy, legislation and international standards and agreements (Earth Charter, 2011).

### **Research Questions**

1. Are sustainability values, as expressed by the international Earth Charter framework for sustainability, implicitly or explicitly present in the national environmental education guidelines, NAAEE's Guidelines for Learning and AP College Board's Topic Outline for Environmental Science? If present, how intensely or frequently are sustainability values expressed in these documents?
2. To what extent do environmental education state standards, Texas, California, New York, Wisconsin, and Colorado, compare to these national and international guideline documents in expression of the presence, frequency and intensity of sustainability values?
3. What dominant discourse, general categories and patterns regarding ecological sustainability and environmental values are expressed in each individual document?

Chapter II will present the literature review and will include research on environmental literacy, the relationship of values to environmental behaviors and an overview of the guidelines that will be analyzed. Chapter III will describe the mixed-methods approach to this content analysis. Chapter IV will show the findings from data collection, which includes quantitative coding, computer text analysis, profiles based on qualitative methods, as well as a triangulation of the findings from all three methods of data collection. Chapter V will offer some concluding thoughts on how sustainability values are expressed through the documents analyzed and how that influences environmental educational approaches in the United States.

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter will begin with an overview of environmental education literature followed by research on environmental literacy among Americans. Also discussed is the lack of core status of environmental education. A review of research on the influence of values on environmental behaviors will be presented. These help to provide a rationale for examining how values are addressed in environmental education standards. The literature review will conclude with the origins and influence of the NAAEE guidelines and the AP course description.

In the 1970's, environmental education literature focused on defining and determining the goals and parameters of environmental education. The 1977 Tbilisi Declaration stated environmental education should be concerned with awareness, knowledge, attitudes and skills that foster participation in new patterns of environmental behaviors (UNESCO, 1977). If people understood local and global impact of their choices, they would change their behaviors. During the 1980's the literature generally examined curriculum development and investigation of the effects of environmental education on environmental behavior outcomes. This research continued into the next decade and began to look at specific factors that impact pro-environmental behaviors such as personality and affective characteristics, knowledge and awareness, environmental worldviews, and values or ethics.

Shaping the definition of environmental literacy and developing ways of measuring it began in the 1990's. Several states commissioned research to collect data



on environmental literacy. There were studies in Florida (Bogan & Kromrey, 1996), Pennsylvania (Johnson & Smith-Sebasto, 2000), Minnesota (Murphy, 2002) and Ohio (Mancl, Carr, & Morrone, 2003). The National Environmental Education and Training Foundation began looking at environmental literacy from a national perspective in 1997 and these reports have continued for nearly a decade (NEETF & Roper Starch Worldwide, 1997, Coyle, 2005).

In 1993, the North American Association for Environmental Education, NAAEE, began creating standards or guidelines for environmental education. The College Board Advanced Placement program added environmental science to its list of courses toward the end of the 1990's. Most recently in 2011, the National Research Council designed the Next Generation Science Standards. This literature review will focus on environmental literacy, environmental education as a core subject, the relationship between environmental behaviors and values, and environmental education standards or guidelines.

### **Environmental Literacy**

The National Environmental Education and Training Foundation, NEETF, and the Roper Public Affairs group have been conducting research on environmental literacy since 1997. A review of this research was compiled and published online by NEETF (Coyle, 2005). The methodology involved yearly telephone interviews of a cross-section of 1,500 American adults and the margin-of-error due to sampling was at the .95 confidence level, (+ or – 2%), (Coyle, 2005). The simple quizzes that were administered are available in Appendix 1 of the report.

The results of the survey showed that two-thirds of adults did not pass the quiz and only one tenth made an “A” on the quiz. Only 12% of those surveyed possessed basic energy awareness; nearly half did not know the main source for energy production is coal. In addition, significant numbers of participants, 80%, believe in common environmental myths. For example, in 1978 CFCs were totally banned from aerosol cans, but 32% of respondents said that spray cans are the only source of CFCs today. Forty-seven percent of respondents said that industry is the most common source of water pollution, while only 22% knew that runoff or non-point sources are the most common sources of water pollution. Thirty-five percent of participants did not know how spent nuclear fuel and rods are stored and 34% said the nuclear material was safely stored out west. The second most missed question asked participants what percent of the world’s water is fresh: only 13% knew that less than 1% of the world’s water is fresh and available for use. Seventy-five percent believed that forests, rather than algae in the oceans, are the main source of oxygen on the planet. Oxygen and fresh water are the most essential elements of life, yet it seems that most Americans do not know basic facts about them. Data from years of study has shown a persistent pattern of environmental ignorance among the population of the United States. (Coyle, 2005).

In terms of demographic data, environmental literacy is correlated with gender, age, geographic location and level of education (Coyle, 2005). More males (43%) than females (21%) received a passing grade. The largest differences between males and females were on topics regarding wetlands, disposal of nuclear waste, the function of ozone and how most electricity is generated. The data indicate that Americans aged 35 to

54 are more knowledgeable than 18-24 year olds. Over 65 year olds scored the lowest. Most of the people in the 35-54 did not receive environmental education during their school years; this reinforces that Americans acquire most of their environmental information from the media. The data did not support the hypothesis that children pass environmental knowledge to their parents because there were no significant differences in the scores between parents and non-parents. Americans from western states tended to score higher than those in other regions, and Westerners also engage in more outdoor recreational activities. Of course, the most significant factor in environmental literacy was the level of education. Americans with less than a high school education averaged 5.8 correct answers compared to 8.6 correct answers among those who graduated from college. (Coyle, 2005)

The state reports on environmental literacy tend to agree with national reports. The 1996 study in Florida included 370 high school seniors from fourteen randomly-chosen schools and tested students based on the state environmental curriculum. Students averaged 37% in their ecological knowledge (Bogan & Kromrey, 1996). The Pennsylvania study involved a telephone survey of 1,000 adults, and over 57% of participants received an F in environmental knowledge (Johnson & Smith-Sebasto, 2000). The Minnesota study also used telephone interviews of 1,000 adults and found that 46% made low or failing grades. The Ohio study surveyed 504 participants by telephone, but did not report a percentage passing. From the data, it appears that Ohioans scored low on materials cycling, diversity and biotic interactions (Mancl, Carr, & Morrone, 2003).

One of the latest reports is a 2010 national study of middle school students, which is deemed as a baseline assessment of middle school student environmental literacy (McBeth & Volk, 2010). Data were collected from a stratified random sample of 2,004 sixth- and eighth-grade students from 48 counties in the United States. The geographic and demographic parameters were weighted to reflect the national population. The Middle School Environmental Literacy Survey, MSELs, was used to assess environmental literacy components of ecological knowledge, intention to act, environmental sensitivity, issue identification, issue analysis, action planning and pro-environmental behaviors (Bluhm, Hungerford, Volk, & McBeth, 1995). Students scored a 67% on ecological knowledge, 42% on issue identification, 47% on issue analysis, and 38% on action planning. These low scores on issue identification, issue analysis and action planning indicate the participants' ability to engage in of critical-thinking and decision-making may not be adequate for resolving environmental issues. In terms of environmental behaviors, students scored 64% on intention to act and a 60% on pro-environmental behaviors. Sixth-graders scored higher in environmental sensitivity than eighth-graders. This suggests that sixth- graders hold moderately stronger affective ties to the environment than eighth-graders. This baseline assessment can be used for longitudinal comparison in years to come, especially if the MSELs is used by future researchers (McBeth & Volk, 2010).

Another issue to address in a discussion of environmental literacy is the general distrust of science or scientists and the political/economic controversy that surrounds many environmental problems. The public discussion has been politically polarized by

well-financed attempts to discount the science (Oreskes & Conway, 2010; Sterman & Sweeney, 2002). Pro-development, anti-regulation conservatives gain political capital by misleading the public and denying established scientific knowledge (Disinger, 2001; Oreskes & Conway, 2010). The controversy over the science may be part of the reason that Americans have less trust in scientists. An American Association for the Advancement of Science (2003) study found that only one-third of Americans trust scientists to put society's interest above their personal interests. The political controversy regarding the effect that humans have as an environmental and geologic force on the planet have added to misinformation and the general lack of environmental literacy among many Americans.

### **Lack of Core Status**

Environmental education, EE, entered school curricula as an add-on to an over-stuffed science curriculum and, after 35 years, it has yet to be considered a core subject (Coyle, 2005; Edelson, 2007). According to the Campaign for Environmental Literacy (2007), only eighteen states have formal EE standards documents, the other 32 states include EE learning objectives in their biology and earth science courses. The states that have formal EE standards are shown in Appendix B. Coyle (2005) also reported that EE may even be in decline with the focus on state testing in math and language arts. After-school programs and informal science programs at museums, zoos, arboretums, etc. provide environmental educational opportunities, but children get 83% of their environmental information from the media rather than schools and other EE programs (Coyle, 2005).

In the late 1990's, the NAAEE (2000) commissioned a nation-wide teacher survey to gather information on how EE is included in classrooms across the United States. From a random sample of 3,900 K-12 teachers, 40% (1,505) responded. Of the 1,505, 61% include environmental topics in their classes. It should be noted that teachers of all subject areas were included and of the fourteen categories of subject areas, only 13% were science teachers. Of teachers who address EE topics, only 4% taught a dedicated EE course and 10% had pre-service training in EE topics or in EE teaching methods. The topics covered in descending order are: recycling and waste management, endangered species, energy, forests and wetlands, and air/water quality. Global warming, deterioration of the ozone layer, acid rain, and population are addressed much less. The majority of teachers who do teach environmental topics, 63%, claimed to teach about the environment for less than 50 hours per year. Among teachers who do not teach EE, 49% claimed that EE is irrelevant to their curriculum. A break down by grade level is shown in Table 1.

Table 1

*Approaches to EE by Grade Level (NAAEE, 2000)*

Grade Level	Teach EE Topics	Use Hands-on	Use Civic Action
K-4	83%	90%	4%
5-8	59%	80%	13%
9-12	45%	55%	19%

This data reflect that more EE is taught in the elementary grades than in high school and that hands-on investigations are less often used in the higher grades. Civic action rises as students get older, but is used by less than 20% of teachers. In terms of educational development, students gain critical, abstract thinking skills as they mature, but they receive most of their environmental education in elementary school. Coyle (2005) noted that the single biggest problem in environmental literacy is the understanding of complicated causal connections. It is a simple one-step causal connection to understand that a factory is polluting a stream or a car's exhaust is putting pollution into the air. But there are more complicated steps in understanding that a car deposits small amounts of oil on roads which is washed into streams by rain, thereby polluting the waterway. Understanding the complicated modeling of global climate change with multi-variables, multi-interactions, changing feedback systems, exponential delayed change and dynamic complexity is difficult. Perhaps this is why global warming is taught by only 37% of teachers that address environmental issues (NAAEE, 2000). Some believe that complacency about global climate change is related to poor systems-thinking skills (Stermann & Sweeney, 2002).

Science teaching is, generally, information-based and too often there is little time to apply, synthesize and evaluate knowledge (Coyle, 2005). Understanding complex causal relationships goes beyond facts, which is why environmental educators focus on the process of learning. Coyle (2005) believes that a shallow approach to EE is the principal stumbling block in achieving wider environmental literacy. The traditional lecture style of teaching does not include the hallmark teaching practices of effective EE

programs such as project-based, hands-on, investigative field work and student-directed learning. Of course, this is a problem for science education in general (NRC, 2007). The baseline data on the environmental literacy of middle school students from the McBeth and Volk (2010) study showed that critical thinking and decision-making was a weak area.

Edelson (2007) makes a compelling argument for the core status inclusion of EE in high school. He claims EE:

- Is an engaging context for learning the fundamentals of science
- Gives an opportunity for students to experience an applied science
- Represents contemporary science in ways that traditional sciences do not
- Integrates core content knowledge
- Has importance for students and society

The traditional sciences (biology, chemistry and physics) are remote from the lives, concerns and interests of many students, but EE begins with the immediate world of the learner (Edelson, 2007). Introducing scientific processes to explain observations of the learner's inhabited world builds on what they know and deepens their understanding (Edelson, 2007). Unlike the well- established traditional sciences, EE presents science that is unresolved; it can be compelling to engage in an ongoing process of science rather than being handed answers and doing verification labs (Edelson, 2007). Because of the inter-disciplinary nature of EE, it does not “carve up the world into slices that correspond to what can be explained by the discipline” (Edelson, 2007, p. 47). In addition, EE can be relevant to student concerns and offer a more aesthetic and



meaningful aspect to learning than the need to pass a test or get into college (Edelson, 2007; Slattery, 2006).

The biggest challenge of high school education in our modern society is providing our diverse student population with a reason to learn that makes sense within their personal value systems. Inclusion of EE as a core subject through systematic K-12 EE standards and implementation of student-centered pedagogies is a step toward achieving environmental literacy and general scientific literacy. A hit or miss, informational approach will not allow students to develop the skills needed to make informed decisions about environmental issues.

### **Environmental Values' Influence on Behaviors**

Environmental education has held the goal of increasing environmental knowledge in the hope of promoting pro-environmental attitudes and behaviors, but has achieved limited success (Chawla, 2006; Schultz et al., 2004). Even though environmental literacy is an important first step toward changing environmental behaviors, there are many other influences that affect pro-environmental behaviors. Knowledge is a necessary, but not sufficient, precondition for developing pro-environmental behaviors (Bamberg & Moser, 2007). Environmental behavior is determined by a myriad of variables and variable interactions; there is no single variable explanation (Stern, 2000). Variables that have been researched over the years include: awareness: worldview; beliefs; attitudes; values; perceived control; social and moral norms; and personal norms such as sense of obligation or responsibility.

Life often involves balancing tensions between important values. Within the realm of environment and sustainability, ecological, social, cultural, economic, political and spiritual values are interconnected (Leigh, 2005; Mukherjee, 2005; Sipos, Battisti, & Grimm, 2008). Human behavior is grounded in values and changes in societal behavior depend on changes in values (Disinger, 2001). Values are aligned with beliefs and cultural norms and, in addition to worldview and personality, are the basis for attitudes and behaviors (Payne, 2010; Schultz and Zelezny, 1999; Stern 2000). The Earth Charter defines values as the departure point which motivates individuals to make decisions and take action (Mukherjee, 2005). Values are different from attitudes because attitudes are evaluations of specific circumstances (Dietz, Fitzgerald, & Shwom, 2007). Norms tend to reflect values and refer to proper actions or rules of behavior within society; norms are about how one ought to behave (Dietz et al., 2007). Beliefs are understandings or facts about the world as an individual perceives them, and worldviews are generalized beliefs (Dietz et al., 2007). Perceived control is estimation an individual has regarding their ability to perform a behavior.

For several decades, environmental education has focused on global issues such as saving the rainforests, protecting charismatic species and global climate change. Environmental educators strive to inspire our children to save the planet, but placing the weight of the world's problems on their shoulders may actually fill them with a sense of hopelessness and despair that could lead to disassociation from the varied and difficult environmental issues (Sobel, 1996). The gloom and doom approach to environmental

education may actually lower students' perceived control of the larger, global environmental issues.

Early research on pro-environmental behavior considered the influence of self-interest and altruism on decision making (Dietz, et al., 2005). People choose pro-environmental behaviors because it is in their self-interest to do so or because they have concerns about others or the biosphere (Stern, Dietz, & Kalof, 1993). With the introduction of the New Environmental Paradigm Scale, environmental worldviews were added to the discussion of what motivates pro-environmental behaviors (Dunlap & VanLiere, 1978). Stern and his colleagues developed the values-beliefs-norms, VBN, theory of environmental concern and behavior (Stern, 2000; Stern, Dietz, & Guagnano, 1995). Values underlie an individual's beliefs, which, in turn, affect personal norms; together, these influence behaviors (Stern, 2000).

Within the literature on environmental education research, an individual's environmental worldview is conceptualized as a person's belief about humanity's relationship with nature, and environmental values are defined in a similar way (Duncan & Van Liere, 1978; Schultz et al., 2004). Environmental value orientations can be conceptualized as a four-dimensional construct: ecocentric (bio-centric); egocentric; anthropocentric; and apathy (Schultz, 2001; Soye, Wunschmann, & Gelbrich, 2010). Individuals with ecocentric value orientations strive to protect nature for its own sake and see themselves as part of nature (Dunlap & Van Leire, 1978; Schultz & Zelezny, 1998; Soye et al., 2010). Individuals with egocentric value orientations want to preserve nature for personal benefits such as recreation or stress reduction and see themselves as

managers of nature (Schultz & Zelenzny, 1998; Soyeze et al., 2010). Individuals with anthropocentric environmental values consider humans to be dominators of nature and perceive the natural environment as a commodity; from this perspective, people are separate from and superior to nature (Dunlap & Van Liere, 1978; Leopold, 1947; Schultz & Zelezny, 1998; Soyeze et al., 2010). Apathetic individuals do not see the need to protect the environment (Soyez, et al., 2010; Thompson & Barton, 1994).

Because cognitive or rational explanations do not sufficiently address why people care about the environment, another line of research examines affective influences on environmental behavior (Kals, Schumacher, & Montada, 1999). Emotional affinity for nature or nature- connectedness was investigated as motivation for pro-environmental behaviors (Kals, et al., 1999; Mayer & Frantz, 2004). Based on Leopold's land ethic, Mayer and Frantz (2004) suggest that belonging or connecting to nature is a key component of fostering ecological behavior and may more profoundly affect ecological values and behaviors than awareness or knowledge. The fact that Americans are generally spending less time in nature means that fewer people are developing an affinity for nature (Louv, 2005; Pergams & Zaradic, 2008).

A 1999 study that examined emotional affinity and pro-environmental behaviors created a questionnaire that was used with 281 German participants, 81 of whom were involved in environmental activism (Kals et al., 1999). Multiple regression analysis revealed that emotional affinity is as powerful to predict nature-protective behavior as indignation and interest in nature and together these three predictors explain up to 47% of variance of the criterion variables. The regression model showed that 39% of

emotional affinity toward nature traces back to present and past experiences in natural environments (Kals et al., 1999). Significant differences were found between the general participants and the 81 who were involved in environmental activism. Attitudes built on direct experience tend to be affectively based and are better predictors of environmental behaviors (Pooley & O'Connor, 2000).

A more recent qualitative study by Chawla (2006) compared 26 environmental activists in Norway with 30 environmental activists in Kentucky as to what motivated them to take action for the environment. When people explained their involvement in environmental action, their reasons were usually very personal. Many mentioned a childhood place where they played or participated in recreational activities as adolescents and a beloved family member who directed them to look closely at the environment around them. Emotional affinity toward nature predicted a willingness to protect nature (Chawla, 2006). It makes sense that affiliation influences emotions and emotions affect values.

In a meta-analysis of psycho-social determinants of pro-environmental behavior, Bamberg and Moser (2007) examined nine variables: problem awareness, internal attribution, social norms, feelings of guilt, moral norms, attitude, perceived behavioral control, intention, and behavior. They found that intention for pro-environmental behavior is mediated by moral norms, attitudes and perceived behavioral control. These variables explain 52% of the variance of the intention for the pro-environmental behavior construct. In addition, problem awareness, internal attribution, feelings of guilt, and social norms explain 58% of the variance of moral norms. Six of the nine variables

used to model pro-environmental behaviors correlated with moral norms or values. This synthesis of research used meta-analysis structural equation modeling, MASEM, on 46 studies published between 1995 and 2006. Because MASEM is based on correlational tests, the findings are informative, but do not allow causal inferences.

Generally, the notion that values are related to environmental behaviors has been established by research. Values have an effect on environmental worldviews. An environmentally literate individual understands that humans are a part of the biosphere and live interdependently within ecosystems. But understanding may not be enough to change behaviors and short-term decision-making. Whether individuals are motivated by self-interest or altruism, values play an important role in affecting environmental behaviors. Environmental values can be influenced by personal connection or affinity to nature, concern for people, concern for the biotic community or by self-interest. Values require a context from which to emerge (White, 2009). Addressing personal and societal values surrounding environmental and sustainability issues should underlie environmental education if the goal is to affect pro-environmental behaviors.

Although there are numerous studies in outdoor and environmental education that examine values, value construction and changes in values, it does not appear that any common standard is applied when evaluating how environmental values are infused into school curricula or standards (Greenwood et al., 2009; Ladwig, 2010; Schultz and Zelezny, 1999; Stern, 1999). This diverse positioning could be attributed to the inherent political and economic nature of environmental issues and the tension, caution and resistance that surrounds them (Greenwood, et al., 2009; Payne, 2010). The

environmental literacy dilemma in the United States will not be resolved until society adopts a consensus environmental and educational worldview (Disinger, 2001). The Earth Charter is a global consensus document, but these international guidelines are not fully reflective of American worldviews and values, which are still mired in controversy. The challenging vision offered by the Earth Charter contains principles that support sustainable development and are a declaration of our responsibility to one another, the larger community of non-human life and to our descendents. A commitment to the future must include the recognition of humanity's interrelationship with the environment, economics, equity and socio-cultural values and norms (Earth Charter, 2011). Ultimately, values are a reflection of the standards that we set.

### **United States Environmental Education Standards**

In 1983, *A Nation at Risk* gave a dismal report on the state of education in the United States (Denning, 1983). One of the report's recommendations called for educational standards; since then, national and state standards have been developed in core subjects to outline the knowledge and skill basics of each learning field (Simmons, 2005). Because the United States' educational system is decentralized, national standards are not binding, but they do serve as guidelines or models for state or local standards. In 1993, environmental educators began the National Project for Excellence in Environmental Education, a program to establish guidelines for environmental education (McCrea, 2010; Simmons, 2005). Funding for the program came from the NAAEE, EPA, National Fish and Wildlife Foundation, Northern Illinois University and World Wildlife foundation (McCrea, 2010).

Bora Simmons was the leader of this effort and, in 2005, wrote an article that recounted the process of developing national environmental education guidelines. The purposes of the guidelines are, of course, to promote environmental literacy, but also to promote unity, coherence, common language and professionalism in the field of environmental education (Simmons, 2005). Simmons conducted extensive research on the processes that produced standards for the core subjects and a conscious effort was made to model the environmental education guidelines after other national standards in structure and format (McCrea, 2010; Simmons 2005). Simmons (2005) noted that some policymakers vilified the newly developed national social studies standards as biased. To be well-received by educators, parents and policy-makers, Simmons realized that the EE standards must be relevant and unbiased to withstand critical scrutiny (McCrea, 2010). For this reason, the EE guidelines emphasize thinking, action and citizenship skills without endorsing any particular worldview or course of action (Simmons, 2005). Even though much of the work in EE addresses affective domain attributes, guidelines specific to affect were expressly not included (Simmons, 2005).

Simmons (2005) pointed out that many EE content objectives are included in other disciplines such as science, geography and mathematics. Also, the guidelines are meant to encourage educators to develop locally relevant EE programming and learning activities (Simmons, 2005). Perhaps this is why the guidelines are very general with few content-specific objectives, and why Simmons (2005) purposefully labeled the document as *guidelines* rather than *standards*. The guidelines are unique from traditional views of curricular disciplines in that there is an explicit focus on integration of EE knowledge



and skills across subjects, as well as a citizen action component (Simmons, 2005). Ultimately, over 2,500 individuals, organizations, NAAEE members, and other stakeholders gave input during the document's development (McCrea, 2010, Simmons, 2005). State educational agencies, such as Wisconsin, have used the Excellence in Environmental Education-Guidelines for Learning (K-12) as the basis for development of their own EE standards (McCrea, 2010).

There is still debate among environmental educators about the value-free approach of the NAAEE guidelines (Disinger, 2001; Greenwood, et al., 2009; Gruenewald, 2004; Wals & van der Leij, 1997). The global movement and consensus for EE as expressed in the Earth Charter and other UNESCO documents include health, social justice and moral/ethical perspectives (Greenwood, et al., 2009). Wals and van der Leij (1997) argue against any standards claiming they maintain a behaviorist, positivist paradigm that is limited in addressing the moral and social implications that surround environmental issues. Gruenewald (2004) believes EE should challenge and transform existing educational practices rather than mimic and comply with them. Disinger (2001) doubts that environmental education can be value free, but educators have an obligation to attempt to be value fair. Indeed, one of the criticisms of EE is the gloom and doom approach that frightens children and imposes environmental values based on overstated worst-case scenarios (Disinger, 2001; Sobel 1998). Still, Simmons (2005) maintained that any attempt to promote pro-environmental values would be met with controversy and might impair the chances of the guidelines acceptance by the broader educational community.

For the Advanced Placement College Board guidelines, college faculty and master AP teachers design each of the 34 courses and exams to cover the information, skills and assignments found in a corresponding freshman college course (The College Board, 2007). Unlike most introductory college courses, environmental science is taught in a variety of departments. The *College Board's Environmental Science Course Description* (2007) is a set of expectations equivalent to an introductory environmental science laboratory course; it approaches the course from a rigorous science perspective rather than from a sociological, political or economic perspective (The College Board, 2007). Still, the expectations include foundational EE themes that underlie the many topics and perspectives that should be included in the study of the environment (The College Board, 2007). These include:

- Science as a process
- Energy conversions underlie all ecological processes
- The earth is an interconnected system
- Humans alter natural systems
- Environmental problems have a cultural and social context
- Human survival depends on developing practices that will achieve sustainable systems.

The College Board's endorsement of environmental science and introduction of the AP environmental course in the late 1990's has played an important role in the decision of schools to offer environmental science and provided credibility that EE may have lacked previously (Edelson, 2007). Teachers report that administrators are more

receptive to an AP environmental science course and schools have found that many students prefer an environmental science course to a second year of chemistry, physics or biology (Edelson, 2007). The AP environmental expectations are more content-specific than the NAAEE guidelines, but like the NAAEE, guidelines are a suggested framework, not a mandate (The College Board, 2007). Similarly to the Earth Charter, cultural/social content and sustainability are addressed in the AP environmental expectations.

Environmental educators have an opportunity to seriously consider the question of what role environmental science can and should play in American high schools in the future. The current focus of educational policy is on standards and accountability and as EE strives to achieve core subject status, it will have to comply with educational norms and expectations. This requires environmental educators to meet the educational norms of an unbiased, value free delivery of information while developing critical, independent thinking skills in the hope that young people will learn to value the environment based on the facts. Research has shown that changing values may begin with cognitive awareness, but it also requires an affective dimension. Environmental education has the potential for transformative educational reform. If transforming the culture of unsustainability is the ultimate goal of EE, the path to that goal is multi-faceted. It includes aspects of the cognitive, affective and psycho-motor domains because transformation involves changing perspectives, values and behaviors (Puge, 2010). Standards and national guidelines reflect the policies that steer the course of EE by what is included and what is excluded. Analysis of these documents can reveal the direction or current

and future trends of EE in the United States. Comparison of standards documents to the Earth Charter will reveal how closely the values expressed are aligned with international values and ethics of environmental and social justice.

### CHAPTER III

## RESEARCH DESIGN AND METHODOLOGY

### Data Sources

A traditional methods section would begin with a detailed description of the participants and the setting of an investigation. For this study, the *participants* are documents, environmental education guidelines and state environmental education standards. Specifically, the North American Association for Environmental Education Guidelines and the Advanced Placement Environmental Education Science Course Description will be analyzed as well as the state environmental high school education standards for Texas, California, New York, Colorado and Wisconsin. The state standards of California, Texas and New York were chosen because of the large populations in these states and the diversity of the geographic locations of west, south and east, respectively. Wisconsin represents the northern region of the United States and has been in the forefront of environmental education. Colorado represents the middle of the country and is known for the outdoor recreation opportunities available to its population. High school standards were chosen to narrow the analysis and because high school students are more likely than elementary children to understand complex ecological and environmental processes. The high school standards examined are found in Appendix C. These standards will be compared to the Earth Charter, which represents international core values of sustainability.

### **Mixed-methods Content Analysis**

Content analysis is a research approach for analyzing text or documents and will be used for the present study. Shapiro and Markoff (1997) define content analysis as any methodological measurement applied to text that identifies the presence, intensity or frequency of some characteristic. Content analysis can combine both qualitative and quantitative processes and the methodology is quite rigorous if systematic procedures are followed (Bazerman, 2006; Porter, 2002; Weber, 1990). Reliability can be quantitatively established through inter-rater agreement where as validity is established by the quality and theoretical relevance of the coding procedures (Hak & Bernts, 2009). A mixed-methods approach broadens the scope of the study and increases the trustworthiness of the findings.

Researchers can focus on the manifest, or explicit content of the texts, and/or the implicit content or latent meaning of the documents to be examined. When focused on quantifying the manifest content, reliability can be high, but the theoretical relevance may be low; if the latent content is qualitatively coded, theoretical relevance is likely to be high, but reliability will be low (Shapiro & Markoff, 1997). Quantitative analysis can determine the presence or absence of key words or concepts, as well as the frequency or intensity of a theme (MacQueen, McLellan, Kay, & Milstein, 2009; Stone, 1997). Qualitative analysis of the texts and of the quantitative results is valuable because it allows for the placement of the information into the context of the bigger picture (Stone, 1997). Quantifying the text can help to categorize it (Stone, 1997). Analyzing both the manifest and latent content through quantitative and qualitative methods is a pragmatic

and well-rounded approach to analysis of these EE documents, therefore this study is a mixed-methods investigation.

Since this study addresses sustainability education from ethical, ecological, environmental, sustainability and social justice concerns, the Earth Charter will be the standard through which the documents will be rated (Kahn, 2010). It will serve as the guidelines for the quantitative coding phase of this investigation. The Earth Charter, an international consensus document, represents a critical and transformational eco-pedagogy. This investigation, which is rooted in the postmodern and post-structural conceptualization that language reflects power, seeks to investigate the dominant discourse and social meanings of environmental education documents through the critical pedagogy expressed in the Earth Charter (Hesse-Biber & Leavy, 2011; Kahn, 2010).

Foundational to this critical theory research approach are several assumptions, beginning with the assumption that educational policy is saturated with text that reflects positions and power (Bazerman, 2007). From a critical theory stance, it is assumed that interrogating texts can reveal traces of the dominant worldview and cultural influences embedded in the text, as well as what has been marginalized, or left out of the text (Hesse-Biber & Leavy, 2011). Examination of the environmental education guidelines and standards can reveal the prevailing values and positions that underlie them (Gall, Gall, & Borg, 2007). In addition, these foundational education documents can be interpreted in relation to the political and social context of ecology and economy, production and consumption, power, privilege and suppression. Another assumption is

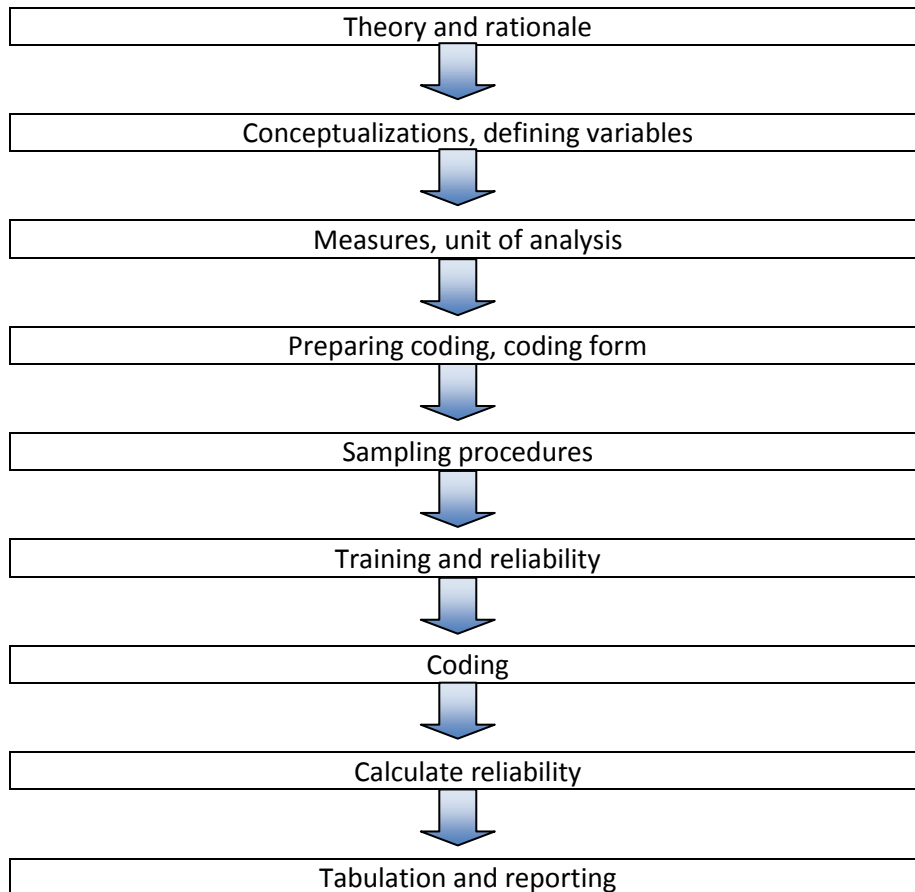
that eco-justice issues are related to social justice issues (Andrzejewski, Baltodano, & Symcox, 2009; Earth Charter, 2000). The same frame of cultural values that allows for destruction and domination of the land and wildlife allows for the devaluing of women and people of different color or from different cultures, especially cultures that are considered to be primitive, uncivilized, less sophisticated or less rational by Western measures (Andrzejewski, Baltodano, & Symcox, 2009; Nabhan & Trimble, 1996; Riley-Taylor, 2002). Finally, this work emerges from an ecocentric worldview and the assumption that one's quality of life and the quality of the lives of future descendents is dependent on the values and cultural norms of society regarding healthy environments, natural ecosystems and sustainable communities (Orr, 1992).

## **Methods**

There is a typical structure to content analysis that is consistent in the literature (Hesse-Biber & Leavy, 2011; Neuendorf, 2002). Figure 1 is a flow chart of this linear process (Neuendorf, 2002). The complete theory, rationale and conceptualization have been stated in the literature review; environmental education guidelines along with state standards will be examined because these reflect EE policies and what is taught. These documents were compared to the Earth Charter because it represents the international consensus for an ethical foundation for an emerging, sustainable world based on respect for nature, universal human rights, democratic justice and a culture of peace (Kahn, 2010). The unit of analysis is sections of standard strands (such as 1.1a-d). The main principles of the Earth Charter make up the codebook. Only principles five through sixteen were used for coding because principles one through four are broad and



encompass the whole Earth Charter framework in general terms (Atkisson, Stucker, Wener, 2008). Principles five through sixteen are specific expressions that are more



*Figure 1.* Typical Content Analysis Process

conductive to assessment (Atkisson, et al., 2008). This is suggested by the Earth Charter assessment tool (Atkisson, et al., 2008). Because principles one through four overlap with the other principles, this overlap could make coding more difficult and ambiguous.

Because of the brevity of standard and guideline documents, the entire documents were coded and random sampling of the text was not an issue.

Three coders participated in a training session that involved discussions of the Earth Charter; rating a standard sample together that was not included in the study; rating another sample independently; and comparison and further discussion of any discrepancies. Often at this stage of the analysis, the codebook is revised based on the coders needs, but the Earth Charter was not revised for this study. Discussion of discrepancies continued until the coders achieved consensus of the meaning of the main principals. Although the coders were very proficient at reading documents, they are not science educators and scientific explanations were sometimes needed for clarification. After training was completed, coding began on the documents that were included in this investigation. Reliability between the coders was calculated with Cohen's kappa on 30% of the total units of analysis. For Cohen's kappa, above 0.75 is considered excellent, between 0.40 and 0.75 is considered fair to good, and below 0.40 is considered poor reliability (Chiappetta & Fillman, 2007). A reliability of 0.53 was established, which is considered fair to good. The coding was then completed on all the documents and a summarization of the explicit and implicit coverage of the Earth Charter principles will be reported in the findings.

Provalis computer text analysis tools, Wordstat 6.1 and QDA Miner 3.2 were used for processing the texts. All texts were filtered through an exclusion dictionary included with the software. This removes common words such as *the*, *and*, *is*, *this*, etc, as well as numbers. All texts were analyzed individually, compared to the other

documents and compared to an eco-values dictionary. Analyzing all the words in the text allows an overall portrayal or characterization of each document, but the data can be overwhelming and difficult to graph; therefore the program offers options as to how many words to include based on frequency or case occurrence. Word frequency bar and pie graphs were generated based on the top thirty words or words related to sustainability values. Most document comparisons were carried out in the crosstab feature that allows the text to be compared to a dictionary as nominal independent variables.

Examining the words that were most frequent may give an overall generalization of the text, but words with less frequency can have importance in the document (Brier & Hopp, 2010). It is essential to go beyond word frequencies and examine word associations and relationships with selected words that may be meaningful, but do not occur with great frequency (Brier & Hopp, 2010). Applying the dictionary feature of the software examines each document's inclusion of chosen words related to pro-environmental values and compares the similarities of all the documents within the dictionary's parameters. In addition to using synonyms to words of interest, proximity plots were created around key words such as values, sustainability, and responsibility (for texts that did not contain the words values or sustainability) and was used in the creation of the eco-values dictionary. Comparison of the different texts with the eco-values dictionary as the independent variable in crosstab allows for a two-dimension and three-dimension graphical examination of the texts in relationship to each other and the terms in the eco-values dictionary.

Determining word frequency is a simple matter of counting, but dendrograms, bubble plots, divisive clustering and proximity plots are based on hierarchical cluster analysis, a common technique for statistical content analysis (Brier & Hopp, 2010). Cluster analysis is a multivariate analysis technique that organizes information based on similarities or dissimilarities and location of words in relation to other words or co-occurrence. This type of analysis is often visualized in a dendrogram, a branching diagram that represents a hierarchy of categories based on the number of shared characteristics (Ganapati, Vraney, & Pisani, 2001). The Wordstat program can conduct first-order clustering, based on co-occurrence, and second-order clustering, based on similarity of terms. Second-order clustering was used predominately because it links words that are semantically related and research suggests that second-order clustering is more effective than first-order (Ahlgren & Colliander, 2008; Provalis, 2010). An example of a dendrogram is shown in Figure 2. It is comparable to biological taxonomic classification trees (Ganapati, Vraney, Pisani, 2001). Jaccard's Coefficient is used to show the similarity of words within the dendrograms (Provalis Research, 2010). When clustering is set for whole text (cases), cosine coefficients are used for clustering and multi-dimensional scaling. The rating for each is the same: one shows high similarity and zero shows no similarity (Provalis Research, 2010). The number of clusters can be chosen, but the software selects the minimal number of clusters (Provalis, 2010). Bubble plots are generated from the dendrograms and show areas of data points in proportion to the relative frequency of the items chosen (Provalis Research, 2010). A bubble graph of

the same data as the dendrogram in Figure 2 is shown in Figure 3. It clearly shows how the words are associated and separated within the text.

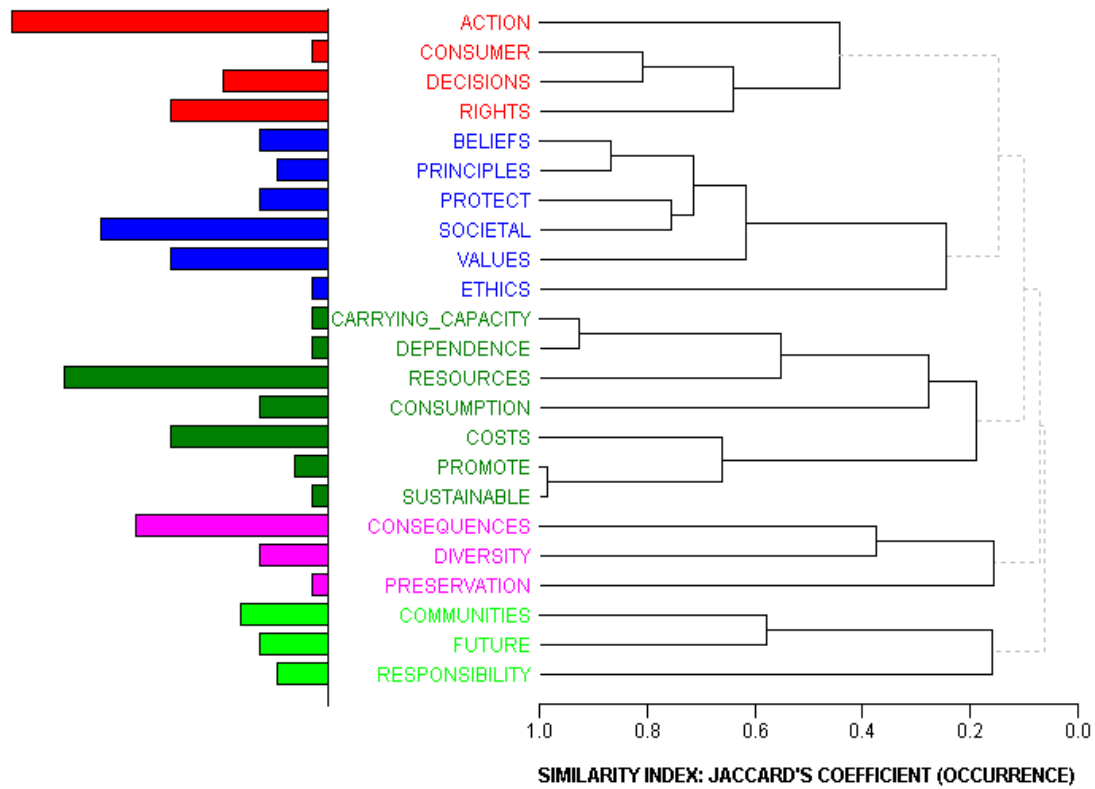


Figure 2. Dendrogram of NAAEE with Eco-values Dictionary

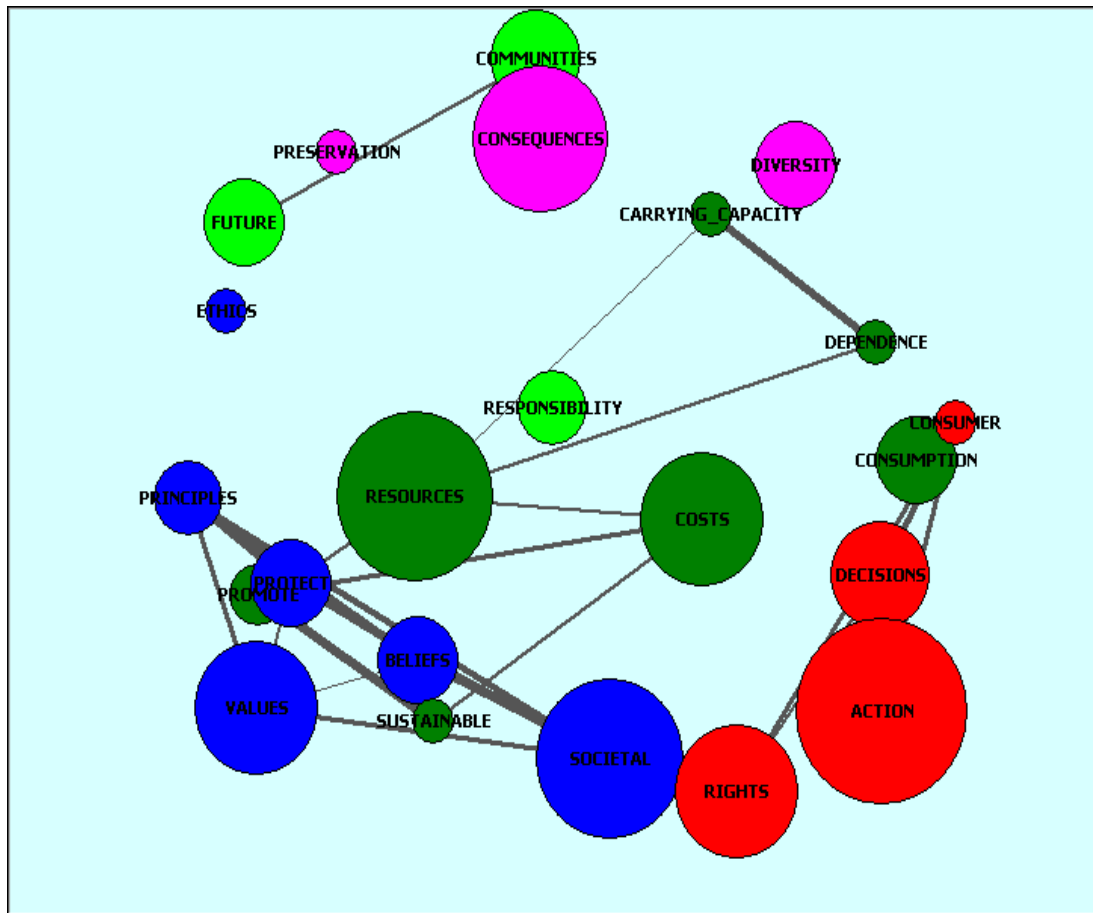
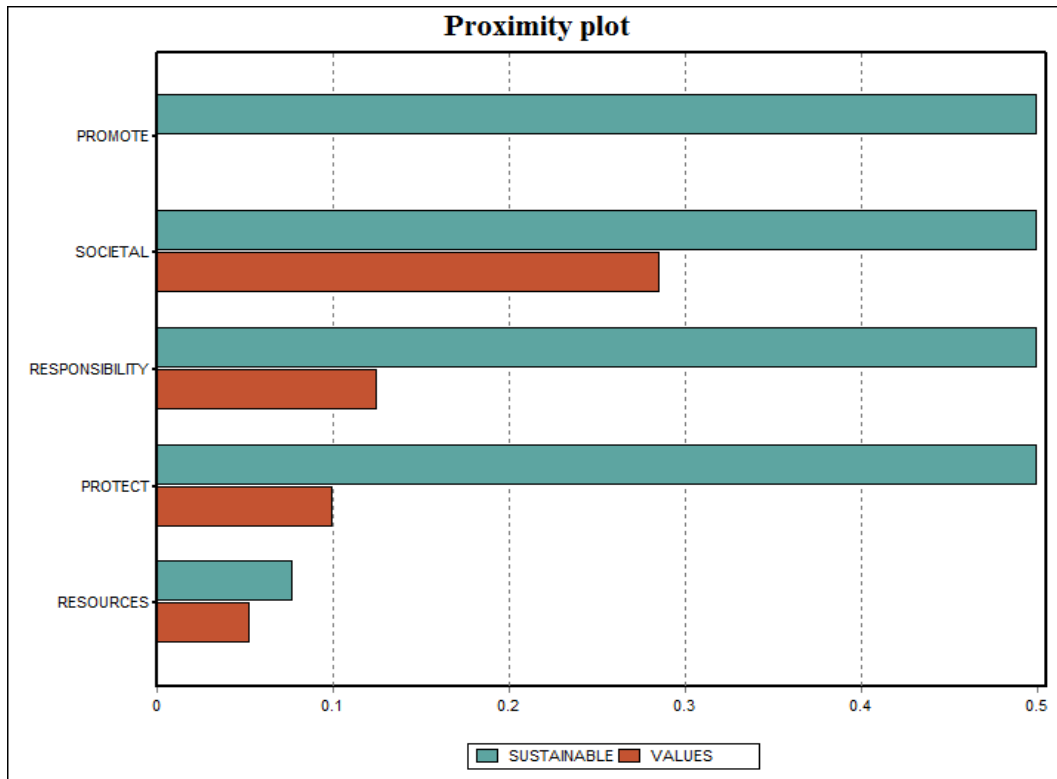


Figure 3. Bubble Plot of NAAEE with Eco-values Dictionary

Proximity plots display co-occurrences of words to a specific word or group of words. A proximity plot is not a data reduction tool, but it is an accurate visualization that graphically shows the distance between target words and other words in the text or between texts (Provalis Research, 2010). A proximity plot is shown in Figure 4. First-order clustering was used to examine co-occurrence of terms around the words *values* and *sustainability*. These analyses help to uncover word associations that assisted in

creating the eco-value dictionary. Terms used in the eco-values dictionary are shown in Figure 5.



*Figure 4.* Proximity Plot of NAAEE to Sustainable and Values with Dictionary (Jaccard similarity units)

Action	Future
Beliefs	Interdependence
Biodiversity	Preservation
Behaviors	Principles
Carrying capacity	Promote
Choice	Protect
Consequences	Resources
Communities	Responsibility
Consumer	Rights
Consumption	Societal
Cost	Society
Decisions	Sustain
Dependence	Sustainable
Diversity	Sustainability
Ethics	Values

*Figure 5. Eco-values Dictionary Terms*

The crosstab feature allows for statistical comparisons of the documents. Application of the eco-value dictionary within crosstabs gives a chi square analysis for how each document expresses these nominal independent variables and how the documents compare to each other within the parameters of the eco-values dictionary (Davi, Haughton, Nasr, Shah, Skaletsky, & Spack, 2005). This is sometimes called supervised clustering (Du, 2010). Another crosstab feature is application of multinomial naïve Bayes to develop a classification probability model, calculate the average precision- probability that the texts are correctly classified, and the average recall or accuracy- probability that the documents are correctly identified in a class (Provalis, 2010). Even though the Bayes probability model assumes independence of terms in text,



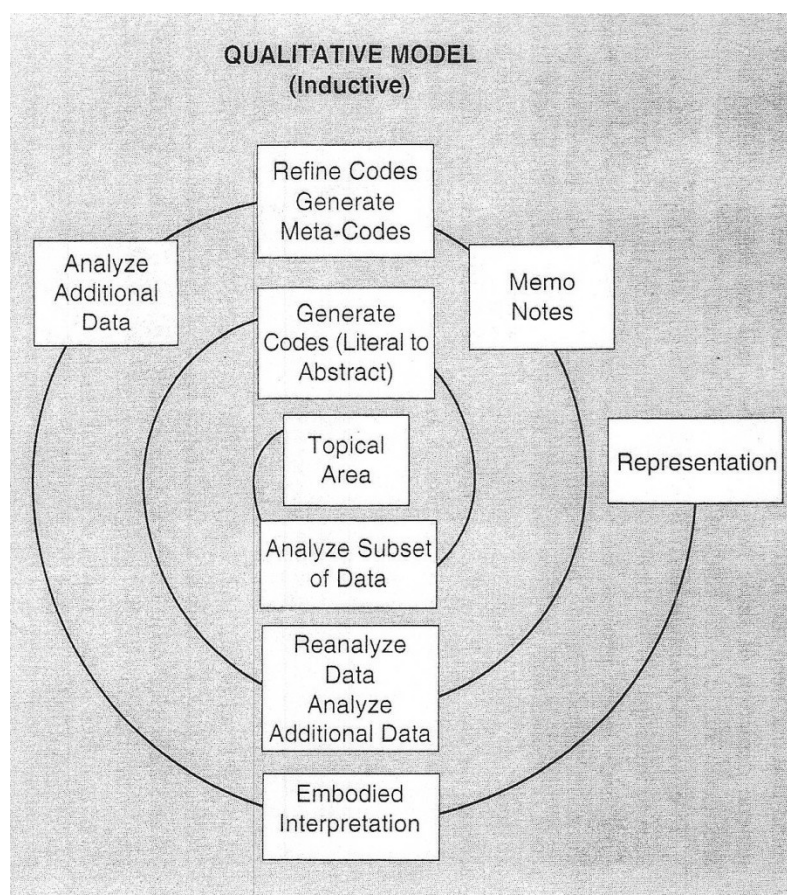
it results in good performance and can be used to refine the independent variables used to model the data (Capdevila & Florez, 2009).

Using the text mining tools offered by computer software programs can generate a huge amount of data from different perspectives. The flexibility of examining individual text or comparing documents helps to address the research questions of general characteristics, discourse of the documents individually, and how these documents align with the Earth Charter and each other. Dendrograms and bubble plots of word frequencies for each document also assisted in creating a general profile and identifying word clusters. Word clusters helped to generate themes based on the predominate use of certain terms in each text.

After the deductive processes were completed, inductive, descriptive analysis was applied to examine patterns and themes within the text as well as to place the quantitative data within a context of pro-environmental worldviews and values (Hesse-Biber & Leavy, 2011). This qualitative approach is influenced by the epistemological and ontological position of sustainability values and seeks to discover how prevailing norms and values of environmental education are represented by the underlying worldviews expressed in the content of the standards and guidelines. This begins with a description of the quantitative data such as word occurrence or frequencies and word co-occurrences independently and in relation to the eco-values dictionary.

Word frequency profiles for each of the documents will be described and categorized in the findings. The use of the quantitative data such as dendrograms, bubble plots, and word frequency graphs facilitated the categorization of each of the documents

in an approach that is grounded in the individual standards text (Hesse-Biber & Leavy, 2011). The quantitative data and complete texts were continually revisited and compared. Figure 6 displays a qualitative framework or model for qualitative content analysis found in Hesse-Biber and Leavy (2011, p. 235).



*Figure 6. Qualitative Model for Content Analysis (Hesse-Biber & Leavy, 2011)*

This spiraled approach to knowledge-building depicts the qualitative research process in a generalized manner (Hesse-Biber & Leavy, 2011). More specifically, code categories were generated directly from the data in relation to the research questions and then the researcher returned to the data to see if the preliminary results made sense, to gain more information, or to apply and refine new code categories (Bazarman, 2006; Hesse-Biber & Leavy, 2011). Terms were categorized, categories were named, terms were shuffled into different groups and categories were more accurately renamed. The researcher continually returned to the text and the varying perspectives of the quantitative data, interpreting, reflecting and refining throughout the process. Hesse-Biber and Leavy (2011, p. 234) describe this spiral model as allowing researchers to metaphorically “dive in and out of the data” as the analysis proceeds.

Allowing the categories to emerge rather than imposing theories on the content advances the construct validation of the investigation and allows for accurate, authentic and truthful portrayal of the documents (Creswell, 2007). The use of the term validity within a qualitative research paradigm is inappropriate, but the credibility or trustworthiness of a qualitative approach to investigation can be enhanced by describing the methods in a way that can be replicated, documenting the rationale for coding categories, confirming results with examples and thick descriptions (Bazarman, 2006; Creswell, 2007). Methodological triangulation of several data collection sources will allow the researcher to cross-examine the findings in an effort to increase the credibility of the results (Creswell, 2007, Denzin & Lincoln, 2005). In addition, the underlying eco-centric perspective and critical theoretical assumptions have been stated to clarify the

research position (Creswell, 2007; Gall et al., 2007). These validation strategies were employed throughout the research and interpretation processes.

## **CHAPTER IV**

### **ANALYSIS OF DATA AND FINDINGS**

This chapter will begin with the analysis of data starting with a description of the quantitative coding, then the computer text analysis and finally, qualitative profiles of each document will be described in detail. The findings will address each of the research questions beginning with an examination of the dominant discourse and inclusion of sustainability values of each of the documents. Then the documents are compared to each other and specifically to the Earth Charter. The comparisons of the quantitative coding, computer text analysis and the qualitative profiles will be triangulated for greater accuracy of the findings.

#### **Analysis**

##### ***Quantitative Coding***

After an acceptable Cohen's kappa was achieved, .53, I completed the quantitative coding of all the documents. The majority of alignment between the Earth Charter and the other documents was in the area of ecological integrity, principles five, six, seven and eight. Principle five discusses the importance of protecting and restoring ecological systems and biodiversity. Principle six states the importance of preventing harm to the environment, preventing pollution and the consideration of short-and long-term consequences of decision-making regarding the environment. Principle seven discusses how patterns of production, consumption and reproduction relate to limited resources. Topics in the standards and guidelines regarding waste management, energy production, consumerism and carrying capacity were coded in principle seven. Principle

eight promotes the advancement of the study of ecological sustainability and preservation of traditional knowledge regarding how to live sustainably. Beyond the principles associated with ecological integrity, the only other principles that aligned with the other documents were in principles twelve and fourteen. Topics about human health were coded in principle twelve; principle fourteen promotes integrating into formal education the knowledge, values and skills needed for a sustainable way of life. As anticipated, of the twelve Earth Charter principles coded, five were not aligned with any of the standards. These covered topics such as eradication of poverty, gender equality, transparency in governance, respecting all living beings, and nonviolence/peace. Perhaps these socio-cultural principles are addressed in social studies learning objectives. These tend to be part of the hidden curriculum or school policies rather than science learning objective, but are essential for a just and sustainable world (Atkisson, Stucker, & Wener, 2008).

The majority of the standards, 89%, were implicitly stated in comparison to the Earth Charter. If similar items/terms found in the Earth Charter principles such as biodiversity (principle 5), pollution (principle 6) or carrying capacity (principle 7) were mentioned as topics of study, it was coded as implicit. When stated in more action-oriented or evaluative terms used in the Earth Charter such as protect, prevent, restore, ensure, affirm, uphold or strengthen, it was scored as explicit. For example: evaluate the role of social, political, and economic institutions in managing change and conflict regarding environmental issues (NAAEE Guidelines, 2.3E) was scored as explicit. The

NAAEE guidelines, Wisconsin standards and Colorado standards had the most explicit statements that aligned with the Earth Charter. Table 2 displays the data from the coding.

Table 2

*Coding: State Standards and National Guidelines Compared to the Earth Charter*  
(No standards aligned with Earth Charter Principles 9, 11, 13, 15 or 16)

E = explicit; I = implicit

Earth Charter Principle	NAAEE		CO		WI		AP		NY		TX		CA	
	E	I	E	I	E	I	E	I	E	I	E	I	E	I
5	4	1	0	0	0	1	0	6	0	5	0	1	0	2
6	1	1	0	0	0	2	0	3	0	1	0	1	0	0
7	2	2	0	0	0	2	0	10	0	3	0	3	0	0
8	0	7	0	6	0	1	0	1	0	3	0	1	0	1
10	2	0	0	0	0	0	0	1	0	0	0	0	0	0
12	0	3	0	3	0	0	0	0	0	0	0	0	0	0
14	1	11	0	4	2	1	1	0	1	0	0	0	0	0
None	1		1		0		9		6		3		1	
Total units of analysis	36		15		10		31		19		9		4	

The NAAEE guidelines aligned with only seven Earth Charter principles. Thirty-three percent of the units of analysis aligned with the areas of learning the knowledge, values and skills for a sustainable way of life which is principle fourteen. Nineteen percent of the analysis units are in the area for the study and promotion of ecological sustainability as in principle eight. The NAAEE focuses more on pedagogy and less on actual subject matter, but there is an emphasis on the topics of ecological systems and biodiversity, which falls under principle five.

The AP course description is essentially a list of topics and is not even stated in terms of learner objectives. Only one item, related to principle fourteen (knowledge, values and skills needed for sustainability) was explicitly stated. Twenty-nine percent of the AP course description units of analysis had no alignment with the Earth Charter. Most of these areas that had no alignment were very specific science topics such as geologic time scale, plate tectonics, Coriolis Effect, cellular respiration etc. Almost one-half of the units of analysis are topic areas implicitly found in principles five, six and seven.

Only 7% of the Colorado standards units of analysis did not align with the Earth Charter principles. Most of the alignment, similar to the NAAEE guidelines, had to do with principles eight and fourteen about advancing the study of ecological sustainability and learning the knowledge, values and skills needed for sustainability. The Colorado document did contain topics related to the environment and human health found in principle twelve. It had more alignment with principle twelve than any other document. The Colorado standards did not address topic areas and no alignment was found in principles five, six or seven. The Wisconsin document had no standards that were not at least implicitly aligned with the Earth Charter. Sixty percent of the alignment was in the topic areas related to principles five, six and seven. Thirty percent of the Wisconsin document was related to learning the knowledge, values and skills needed for sustainability. The document had a similar coding pattern to the NAAEE guidelines.

Over 32% of the New York standards units of analysis did not align with the Earth Charter and most of the alignment was in the topic areas related to principles five,



six and seven. The areas that did not align were related to scientific processes such as hypothesis formation, scientific theory and lab safety. The majority of the standards in the Texas document had to do with patterns of consumption, resource management and issues of carrying capacity, which relates to principle seven. Thirty-three percent of the Texas standards units of analysis do not align with the Earth Charter. Most of the information that did not align was about science processes such as inquiry. The California standards were the least aligned with the Earth Charter, but the document also had the fewest units of analysis. Most of the alignment was in the area of biodiversity and ecological systems found in principle five of the Earth Charter.

To summarize, it appears the AP, California, Texas and New York documents were the least similar to the Earth Charter principles. These documents tended to be topic-driven and mostly aligned to principles five, six and seven. These relate to ecological systems and biodiversity, effects and reduction of pollution, and patterns of production and consumption that affect the quality of the environment. Although the Colorado standards implicitly address only three of the principles, only one standard strand did not align with the Earth Charter principles. The NAAEE guidelines appear to be the most similar to the Earth Charter, followed by the Wisconsin standards. Both of these address a variety of principles and have very few standard strands that do not at least implicitly align with the Earth Charter. Percentages are given in Table 3 shown below. Still the five principles from the Earth Charter that address justice concerns are not included in any of the environmental education documents analyzed. Ecological,

environmental and pedagogical aspects are the focus and the underlying socio-cultural context of social justice, economics, or racial and gender inequalities is missing.

Table 3

*Coding Percentages Based on Unit of Analysis* (No standards aligned with Earth Charter Principles 9, 11, 13, 15 or 16)

<b>Earth Charter Principals</b>	NAAEE	CO	WI	AP	NY	TX	CA
5	14%	0	10%	19%	26%	11%	50%
6	6%	0	20%	10%	5%	11%	0
7	11%	0	30%	32%	16%	33%	0
8	19%	40%	10%	3%	16%	11%	25%
10	6%	0	0	3%	0	0	0
12	8%	27%	0	0	0	0	0
14.	33%	27%	30%	3%	5%	0	0
None	3%	7%	0	29%	32%	33%	25%

### *Computer Text Analysis*

The NAAEE text is the largest of all the documents with over 5,000 words. The AP has less text with almost 1,000 words and the Earth Charter has around 1,800 words. A chart of the word counts of all eight documents is found in Appendix D. Dendrograms of the three texts, based on second-order clustering, showed that the AP course description and the NAAEE guidelines are more similar to each other than the Earth Charter, but the Earth Charter is more similar to the NAAEE guidelines than the AP course description. The correlations between the whole documents are actually very low; the cosine similarity index is below 0.1 between all three texts.

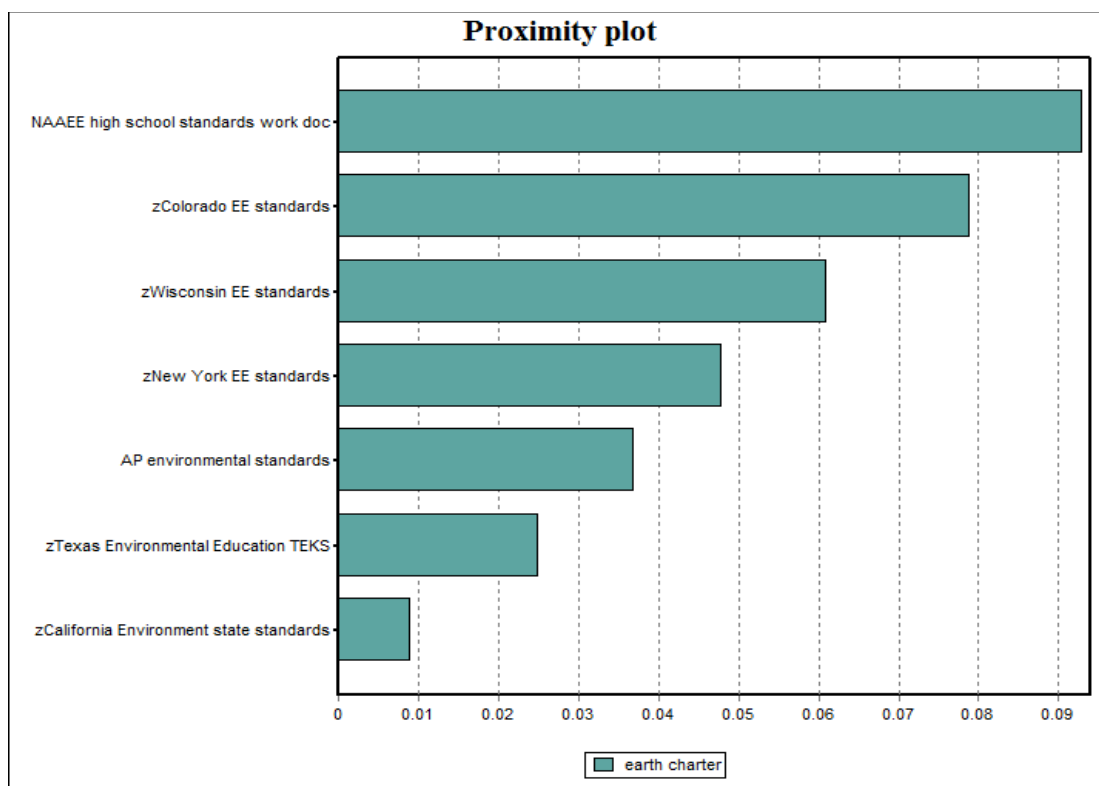
The eco-values dictionary, shown in Figure 5, was applied to analyze the documents with a focus on terms related to environmental values and sustainability. Of

the 30 eco-value terms, the Earth Charter contained nineteen of them; the NAAEE guidelines had twenty-three and the AP had only eleven. The AP course description does not even contain essential eco-values terms such as: *values*, *ethics*, *responsibility*, *protect*, *beliefs*, etc. The AP does cover sustainability more thoroughly than the NAAEE. In this 5,000 plus word document, sustainability and its derivatives are only mentioned twice, but the NAAEE used the word *values* nine times. In both the Earth Charter and the NAAEE guidelines, the word *values* is 0.002% of the total text.

The bubble plots generated from the dendrograms were used to observe how the terms from the eco-values dictionary grouped or associated. In the NAAEE, environmental agency terms grouped and eco-value words such as *societal*, *responsibility* *protect* and *ethics* grouped. *Consumer* was an outlier. *Beliefs* overlapped with *action*. In the Earth Charter bubble plot, most of the words cluster together with outliers of *consumption*, *consequences* and *biodiversity*. In both the Earth Charter and the NAAEE guidelines, *sustainable* and *values* overlapped or were very close together. *Resources* and *protect* also overlapped or were very close in both documents. The AP bubble plot had only eleven words and the only overlap was between *resources* and *sustainable*. When forced into another cluster (to try to draw out more differentiation), *resources* and *consumption* associated. These bubble plots are found in Appendix E.

Analysis continued to include the state standards and how they align with the Earth Charter, eco-values, the NAAEE guidelines and the AP course description. Dendrograms were generated for all the documents as full text and through the eco-values dictionary. Reporting will begin with the full text. The NAAEE guidelines and

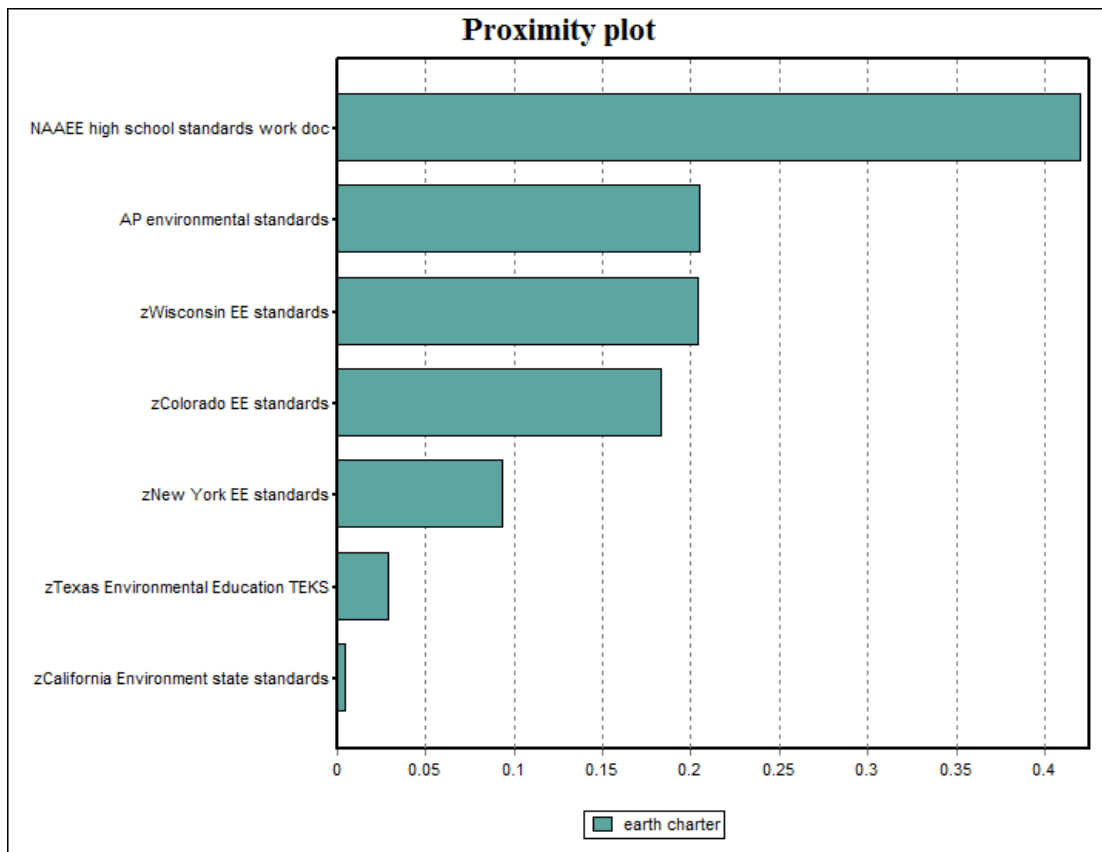
the Colorado standards show a cosine similarity index of 0.3. These two show a cosine similarity index of 0.18 to the Wisconsin standards. New York and Texas show a cosine similarity index of 0.15 and less similarity to the AP and the California standards. The proximity plots that compared full texts as cases made the similarities and differences more apparent. When the seven documents were compared to the Earth Charter, The NAAEE texts were the most similar, followed by Colorado standards, then the Wisconsin standards. California standards and Texas standards were the least similar to the Earth Charter. This proximity plot is shown in Figure 7.



*Figure 7.* Proximity Plot of Full Texts to the Earth Charter (Jaccard's coefficient similarity unit)

Divisive clustering, forcing all texts into one cluster, then two, three and so on showed how the texts group together, separate and regroup. An examination of the divisive clustering showed that the California document was the least similar to the other texts and was the first document to separate from the other texts when forced into two clusters. When forced into three clusters, The AP, New York and Texas documents formed one grouping, the Earth Charter, Colorado, Wisconsin and NAAEE texts grouped together. At four clusters, the Earth Charter forms its own cluster. The Texas standards separate from the AP and New York documents to form a fifth group. When forced into six clusters, the NAAEE text forms a sixth group separating from the Wisconsin and Colorado standards. At seven clusters, the Colorado standards separate from its group. Finally, at eight clusters, the AP and New York texts separate. This progression is shown in Appendix F.

The proximity plots of the texts that appear from the eco-values dictionary compared to the Earth Charter is shown in Figure 8. The NAAEE text is still the most similar to the Earth Charter. The AP text and the Wisconsin standards are second and third. Texas and California are still the least similar to the Earth Charter. Proximity plots that compare the state documents to the Earth Charter, NAAEE guidelines and the AP course descriptions in a three-line bar graph is shown in Figure 9. The NAAEE tends to dominate the graph and the Earth Charter is the least similar to the state standards.



*Figure 8.* Proximity Plots of All Texts with Eco-values Dictionary Terms Compared to the Earth Charter (Jaccard's coefficient similarity units)

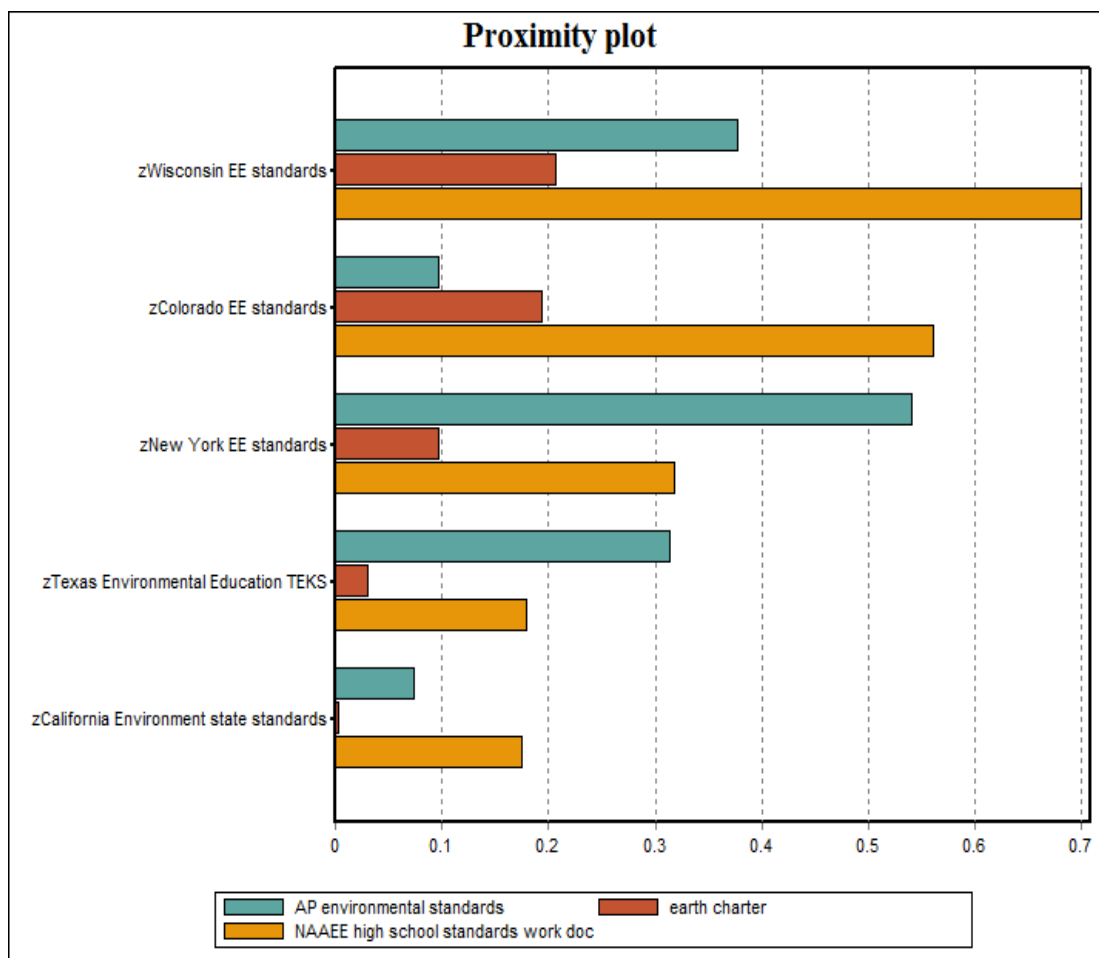
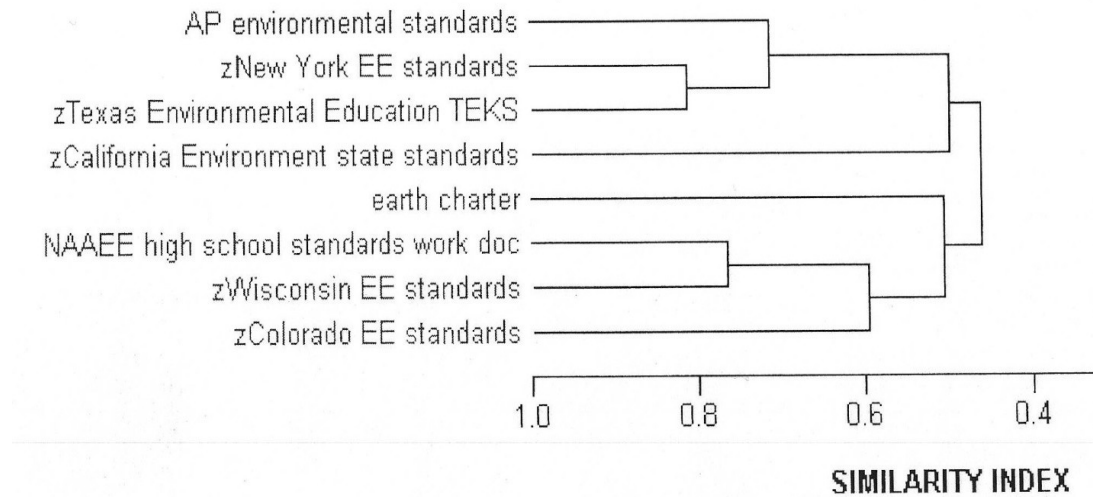


Figure 9. Proximity Plot of the State Standards to the NAAEE, AP, EC with Eco-values Dictionary (cosine similarity units)

In the Wordstat program, the crosstab option allows for the eco-values dictionary to be used as an independent variable and for a more accurate statistical analysis of the comparison of the texts. The dendrogram shown in Figure 10 was formed with the crosstabs feature. It clearly shows that the New York and Texas state standards are very similar and group with the AP course description. The NAAEE guidelines and the

Wisconsin standards are similar and form a group with the Colorado standards. The Earth Charter and the California standards are the least similar to all the other text.



*Figure 10.* Dendrogram of All Text in Crosstab (cosine similarity units)



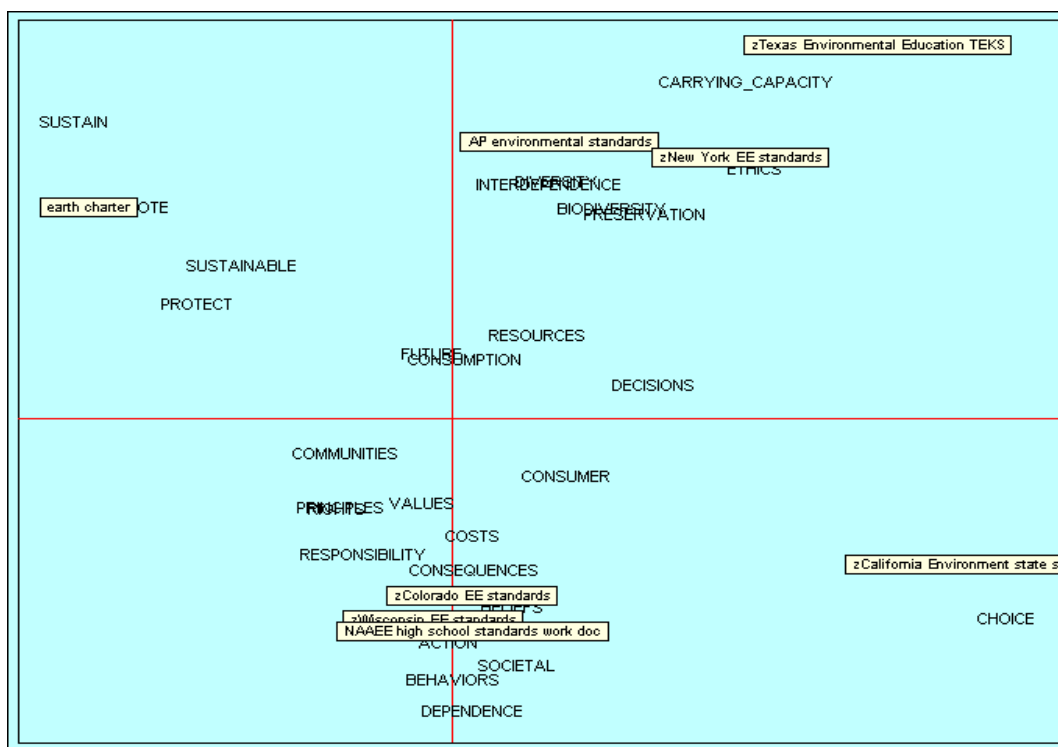


Figure 11. Correspondence Analysis of Texts and Eco-values Dictionary in Crosstab

The correspondence analysis in Figure 11 shows the texts in relation to the eco-values dictionary in a two-dimensional graph. It clearly aligns with the previous dendrogram. It shows the Earth Charter alone in the left upper quadrant and words such as *sustainable*, *protect*, and *promote*. The California standards are in the right lower quadrant and do not group with other texts. The dendrogram shows that the Earth Charter and the California standards are the least similar to the other documents. In the right upper quadrant, the AP, Texas and New York standards cluster near words that relate to environmental and ecological education terms. In the center lower area the NAAEE, Wisconsin and Colorado text cluster near words like *action*, *consequences*,

*behaviors* and *responsibility*. The dendrogram of how the independent variables group is shown in Appendix G.

Using the naïve Bayes probability model, the average precision was calculated at 0.8125 and the average accuracy was 0.8750 on a scale from zero to one. This reflects high precision and accuracy in categorizing the documents with the independent variables of the eco-values dictionary. It should be noted that terms were removed from the eco-values dictionary to test the effect on correspondence graphs, accuracy and precision. Removing terms allowed for the variable *values* to appear on an axis, but the documents continued to group similarly to the original plot shown in Figure 5. Several attempts to remove different terms were made to try to increase the precision and two of the correspondence graphs for these attempts are found in Appendix H. These attempts reduced the Naïve Bayes precision and accuracy calculations.

### ***Profiling of Documents***

This phase of analysis began with an examination of the top word frequencies of each of the texts. In addition, all words were examined in a frequency table to look generally at terms contained or omitted from each text. An examination of the most frequent words shows a definite contrast between the documents. The top five words in the Earth Charter are: *life*, *human*, *sustainable*, *promote* and *earth*. These words relate to sustaining life. The top five words in the NAAEE guidelines are: *issue(s)*, *learners*, *explain*, *evaluate* and *environment*. These are science- teaching terms and environmental agency terms. The top five words in the AP course description are: *energy*, *laws*, *population*, *global* and *systems*. These are ecological and environmental education terms.

This aligns with the initial impressions from early readings of the documents that the AP text covers science topics; the NAAEE guidelines cover pedagogy and environmental agency.

The analysis continued with seeing how words from the eco-values dictionary were associated with terms from each text or if eco-values words were even included in the documents. Proximity plot associations with terms such as *values*, *sustainability* and other eco-value oriented terms were examined. Proximity plots with values as the keyword showed words that associate with the term. The top words in the NAAEE guidelines that associated with *values* are: *principles*, *beliefs*, *societal*, *conflicting*, *shared*, and *impact*. In the Earth Charter, words like *long-term*, *important*, *tensions*, *traditions*, *difficult* and *future generations* associated with values. *Development*, *societies*, *build*, *education*, and *ensure* were the top words that associated with the word sustainable in the Earth Charter. In the NAAEE, *footprint*, *trends*, *carrying capacity*, *ecological*, *growth*, *consumption* and *property* associated with sustainable/sustainability.

Words were grouped initially based on first-order dendrogram clusters, but were further refined into more definitive categories based on word meanings rather than word locations. The following categories of terms were formed: general education, science education processes, ecology, environmental education, environmental agency, economic, sustainability eco-values terms and life supporting terms. Science education processes include words related to the nature of science, inquiry, and general science education pedagogy such as evaluate, analyze, evidence, modeling, or investigation. Words such as learners, educators, experience or settings related to education, but not

specific to science education, are categorized into the general education area. Ecology terms (systems, cycle, natural processes) and environmental terms (pollution, population, management) are similar, but the contrasting division is that environmental terms involve human interactions with the environment. Energy in ecosystems is placed in the ecology category, but energy production is categorized in environment. Environmental agency terms are related to environmental issue analysis, decision-making and environmental action. Examples of economic words are: cost, consumer, development, and economic. Sustainability eco-values terms involve words that are about responsibilities to preserve and protect the natural environment for future generations and also include synonyms for the word values such as ethics, morals and principles. Examples of life supporting terms are life, human, health, communities and interdependence. Examples of how many high-frequency specific words fall into the categories can be found in Appendix I. Each text was analyzed to see how words tended to group within the categories.

## **Findings**

This section will discuss the findings from the analysis of data. It begins with an examination and profile of each of the documents to answer research question three: What dominant discourse, general categories and patterns emerge naturalistically from each individual document independent of comparisons to other text? Each document will be profiled by examining the format, high-frequency words, unique qualities, and how each document associates with the different categories generated from the qualitative analysis. In addition, the use of the terms *values* and *sustainability* will be included.

Next, the first two research questions that ask about the comparisons of the documents will be addressed. How the national and state documents align with the Earth Charter, and how the Earth Charter, national guidelines and state standards compare will be discussed. A triangulation of the data from the different data collection methods will be included in the comparison of the documents.

### ***Research Question 3: Profiles***

What dominant discourse, general categories and patterns regarding ecological sustainability and environmental values are expressed in each individual document?

#### **The Earth Charter**

The format of the Earth Charter is unlike any of the other standards documents. It was created to be applied to any organization so it is more generalized than an educational standards document. The consistent use of the term *principle* rather than *tenants* or *standards* is meaningful. Principles are fundamental doctrines that are used to guide actions. To a great extent, the Earth Charter is a call to action because every principle and sub-principle begins with active verbs such as promote, restore, preserve, protect, uphold, ensure, empower or strengthen.

The Earth Charter focuses on humanistic values for building sustainable communities and the responsibilities of the present generations to the next. Indeed, the words *sustainability*, *sustainable* or *sustain* are used eighteen times in the Earth Charter. The word *values* is used four times and the word *ethics* is used twice in this 1,800 word document. The word *community* appeared nine times. *Responsibility* or varieties of the word were used five times and the word *duty* only appeared in the Earth Charter. In

addition, there are several terms related to aesthetics or affect that are not found in the other texts such as: aspirations, awakening, beauty, compassion, dignity, flourishing, harmonize, heart, joyful, love, vision, wholeness and wisdom.

Looking over the high-frequency words (life, human, earth and health) the trend would seem to be that the document falls into the sustainability eco-values and the life-supporting categories. The fact that all the principles began with an action word should also be considered in categorizing the Earth Charter. Many different verbs were used; therefore many of these terms did not show great frequency. The consistent use of action verbs implies that much of the document could be included under the category of environmental agency. In addition, many environmental and economic terms were used in the document. Terms from the Earth Charter fell less often in the categories of science education process and general education. General ecological terms appeared in the Earth Charter such as *ecosystems* or *biodiversity*, but more specific terms such as *organism* or *species* were not in the document.

The inclusion of principles related to gender equality, race equality, nonviolence, peace, and economic justice shows the recognition that environmental preservation is connected to social justice and that environmental degradation is associated with hegemonic forms of power such as patriarchy, racism and sexism (Andrzejewski, Baltodano, & Symcox, 2009; Kahn, 2010). This is the most unique aspect of the Earth Charter. Because it includes cultural, socioeconomic and political issues with environmental concerns, it builds a strong ethical foundation for a sustainable society

and is a bold educational formulation of how people should maintain relations with nature and each other (Kahn, 2010).

### **NAAEE Guidelines for Excellence**

As mentioned in Chapter II, the NAAEE guidelines were purposefully formatted similarly to other national education standards (Simmons, 2005). The word *standards* was also purposefully not used in recognition that these guidelines are not a mandate, but are meant to promote environmental literacy education and acceptance by the educational community (Simmons, 2005). The guidelines are categorized into four strands: Questioning, Analysis and Interpretation Skills; Knowledge of Environmental Processes and Systems; Skills for Understanding and Addressing Environmental Issues; and Personal and Civic Responsibility. Strand one covers science educational processes. Strand two covers natural processes, resources, and the political and economic conflicts involved in environmental issues. Strand three involves interactions between people and ecosystems, the importance of place to human identity and issue analysis based decision making. Because of the emphasis on issue analysis, the strong influence of an STS teaching approach is apparent. Strand four encourages analyzing societal values, principles, rights, and responsibilities of citizenship and civic engagement. The strands are broken into topics that are stated as learning objectives (learners are able to, learners understand, learners will apply); this why the term *learners* has the greatest frequency in the document.

As high-frequency words were examined, the terms were categorized into science education processes (explain, evaluate), environmental agency (issues, action),

and ecology (energy, systems). The term *issues* is used 55 times. Terms that seem to be missing or had a very low frequency for an environmental education document are: *biodiversity*, *behaviors*, *advocacy*, *conservation* (1 time), and *pollution* (2 times). Less frequent words fell into other categories for example, terms such as *economic* (24 times), *development* (10 times) and *cost* (10 times) are economic terms. *Responsibility* (7 times), *consequences* (11 times), *ethics* (3) and *values* (9 times) are sustainability eco-value terms. Words that are included in the environmental education category are: *effects* (26 times), *energy* (20 times), *global* (13 times) and *local* (9 times). The NAAEE guidelines seem to have a generalized approach and cover all of the themes generated by the text analysis. Science, geography, and economics are integrated in the document.

The integration of different subject matter (science, geography and economics) is a unique aspect of the NAAEE guidelines because most national guidelines are very subject- specific. Another unique aspect is the inclusion of the sub-strand on places in strand 2.4B. Even though most of this strand section is related to geography and geology, the importance of places to human identity is also included. The inclusion of a whole strand on personal and civic responsibility is also unique in educational guidelines. Although almost all school districts have a policy, mission statement or goal that includes citizenship, very few specific educational guidelines or standards incorporate citizenship skills or objectives in every grade level.

Several times the document calls for learners to examine their personal and societal values. Strand 3.2A includes evaluation of values for decision-making, citizenship skills and the need for citizen action. Strand section 4A specifically states



that learners should know how to analyze shared and conflicting societal values expressed by banks, corporations, lobbyists, governmental agencies and the courts. Strand section 4D discusses learners accepting personal responsibility for their decisions and actions. Although no particular values are advocated, the document calls for students to consider ways that the decisions of one generation can create opportunities or impose constraints for future generations. To some extent, it promotes sustainability values implicitly, without using the term *sustainability*, and may not be as value-free as some postmodern environmental educators have purported (Greenwood, Manteaw, & Smith, 2009; Gruenewald, 2004).

### **AP Environmental Education Course Description**

The format of the AP course description, as previously stated, is a list of topics that does not contain actual learner objectives. Most of the document contains phrases rather than complete sentences. Examination of the most frequent words places the document firmly in the ecology and environmental education categories. Ecology terms include *energy, laws, systems, species, and ecosystem*. Environmental terms include *global, population, environment, and effects*. Some words that are not included in the document are: *values, ethics, responsibility, recycle, nature, local, decision or action*. It does, however, use the word *sustain* five times. The word *sustain* is used under topics such as human population, agriculture, fishing, mining and economic impacts. The generalized introductory material does state that humans have an impact on natural systems, that environmental problems have a cultural context and that human survival

depends on practices that achieve sustainable systems. This is the closest the document comes to promoting sustainability.

Unlike most of the standards documents, the AP course description does not have an extensive section on science education processes terms. The small section on laboratory and field investigations is the only place in the document that contains any verbs such as observe, develop, communicate etc. This lack of action terms reflects the lack of environmental agency found in the document. Economic terms were rarely used. Because it does not contain words related to *values*, very few terms, other than *sustain*, were found that would be included in the sustainability eco-values category. For this document, categorization of the most frequent words was an accurate representation of the document even after a more detailed observation. The theme of AP course description tends toward only two categories, ecology and environmental education.

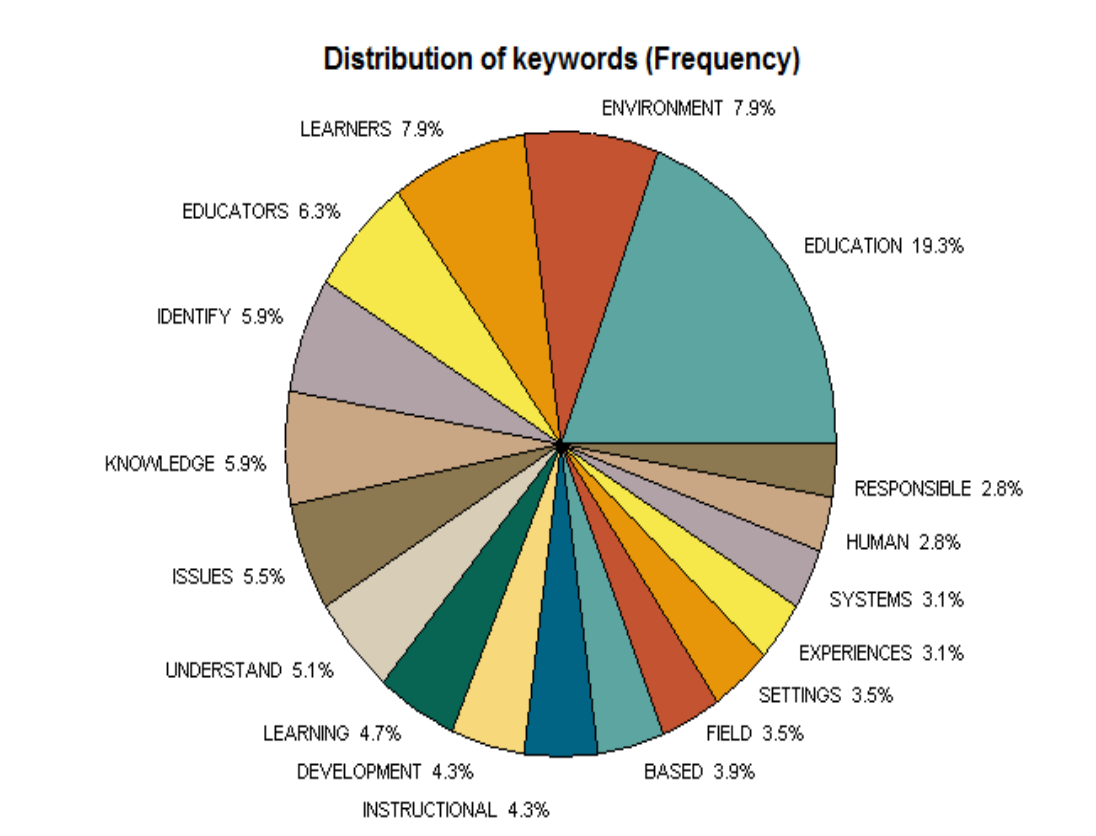
### **California State Environmental Standards**

The California environmental standards are embedded within the biology/life sciences and earth sciences standards. It is also the shortest of the documents analyzed. It has a format common to most standards, topics with specific student learning objectives in an outline form. The topics include: ecology, energy in the Earth system and biogeochemical cycles. The rest of the document lists objectives for investigation and experimentation. The most frequent words are *energy, earth, carbon and ecosystem* which are words related to ecology. One-fourth of the document describes science education processes. There are few words related to environmental education and the document has very few standards related to human interactions with the environment.

Terms such as *agriculture, mining, health, finite resources* or *pollution* are not included in these standards. Also not found are the words *values, sustainable, responsibilities, protect, preservation* or *principles*. Similarly to the AP course description, the California standards can be characterized by the high-frequency words. These standards are not inclusive of sustainability values and tend to be oriented toward ecology and science education processes.

### **Guidelines for Environmental Educators in Colorado**

Colorado has environmental standards that are not embedded in life and earth science standards, but they are found on the Colorado Alliance for Environmental Education website rather than the Colorado State Department of Education. Learner outcome statements are not present. The five themes are: Environmental Literacy; Foundations of Environmental Education; Professional Responsibilities; Planning and Implementing Environmental Education; and Assessment and Evaluation. The first theme, Environmental Literacy, includes the same strands as the NAAEE: questioning and analysis skills; knowledge of environmental processes and systems; addressing issues; and personal and civic responsibility. The section on knowledge of environmental processes and systems is very brief for an environmental education document. The environmental literacy theme also includes a strand called environmental sensitivity, which addresses awareness and connection to the natural world. The environmental sensitivity strand discusses sense of place, integration of subject matter, and outdoor field work. This strand and the themes regarding environmental educators are unique to the Colorado standards.



*Figure 12.* Colorado Standards: Top 30 Words Pie Chart

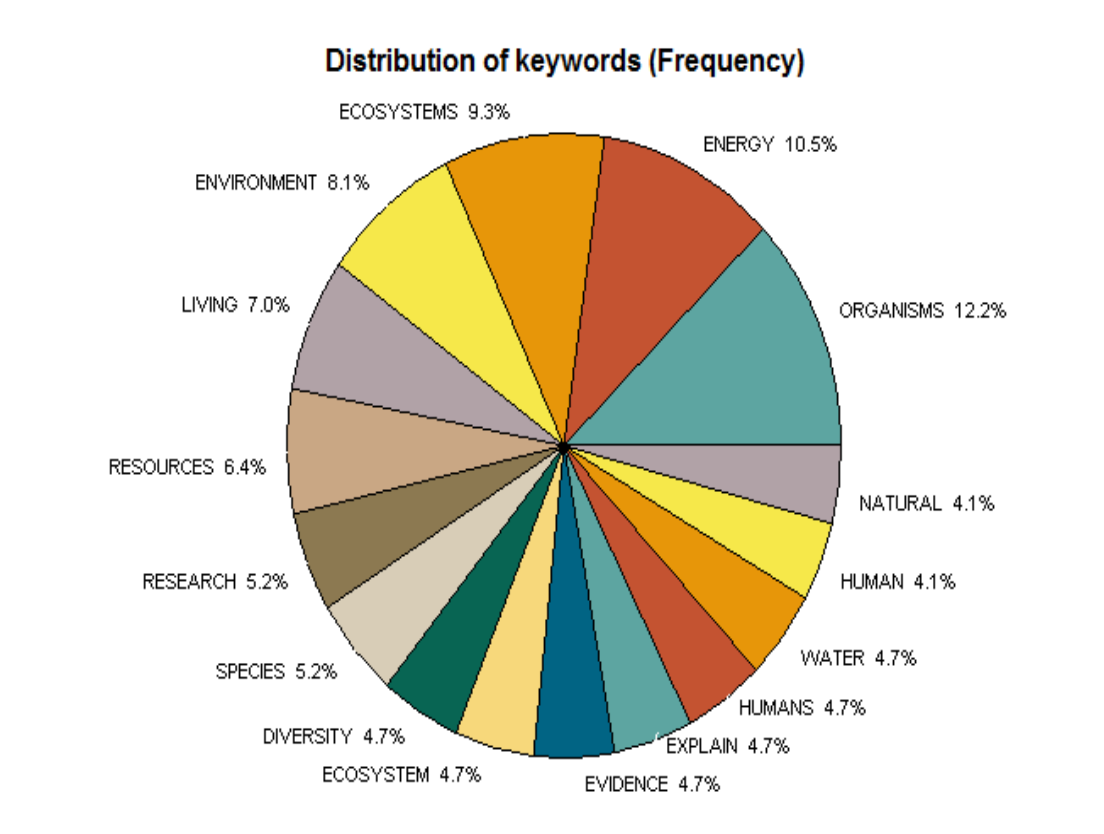
The most frequent words in the Colorado standards, as seen in Figure 12, are *education* (49 times), *environment* (20 times), *learners* (20 times), and *educators* (15 times). A word frequency pie graph is shown in Figure 12. These are in the category of general education. The word *issues* (14 times) is an environmental agency term. *Field* (9 times), *settings* (9 times) and *experiences* (8 times) speak to the focus of this document on outdoor education and on how environmental education is implemented. This document is the only document analyzed that contains both the word *outdoors* (4 times)

and the word *places* (3 times). Other than the word *environment*, the document has very few terms related to the ecology and environmental education categories. Words like *biodiversity*, *pollution*, *renewable*, *carrying capacity* and *water* are absent. The words *values* and *sustain* are both used twice but are not emphasized or related. The term *values* is used in reference to values of stakeholders and the role of values in personal and civic responsibility. This document focuses on environmental agency and on general education with its emphasis on the role of the educator.

### **New York State Environmental Standards**

The New York environmental standards are embedded in the life and earth science standards. The document follows the common outline format for subject standards, but statements are not in explicit learner-outcome form. The learner is implied in some statements such as: devise ways, refine research or use methods. Although it is topic-oriented like the AP course description, unlike the AP, the New York standards are written in complete sentences. They are more detailed and specific. The topics cover scientific processes, diversity of populations within ecosystems, biochemical processes, factors that limit growth, importance of biodiversity, human impact on the natural world, and sustainability. The word *sustain* is not used in this document, but the last section is inclusive of matters essential to sustainability. Sub-section 7.3b specifically states: “The decisions of one generation both provide and limit the range of possibilities open to the next generation.” This is a definition of sustainability. The entire section seven lists topics related to the profound impact that human decisions and activities have on the

natural world. Computer text analysis would not have revealed this emphasis on sustainability since the term was not actually used.



*Figure 13.* New York Standards: Top 30 Words Pie Chart

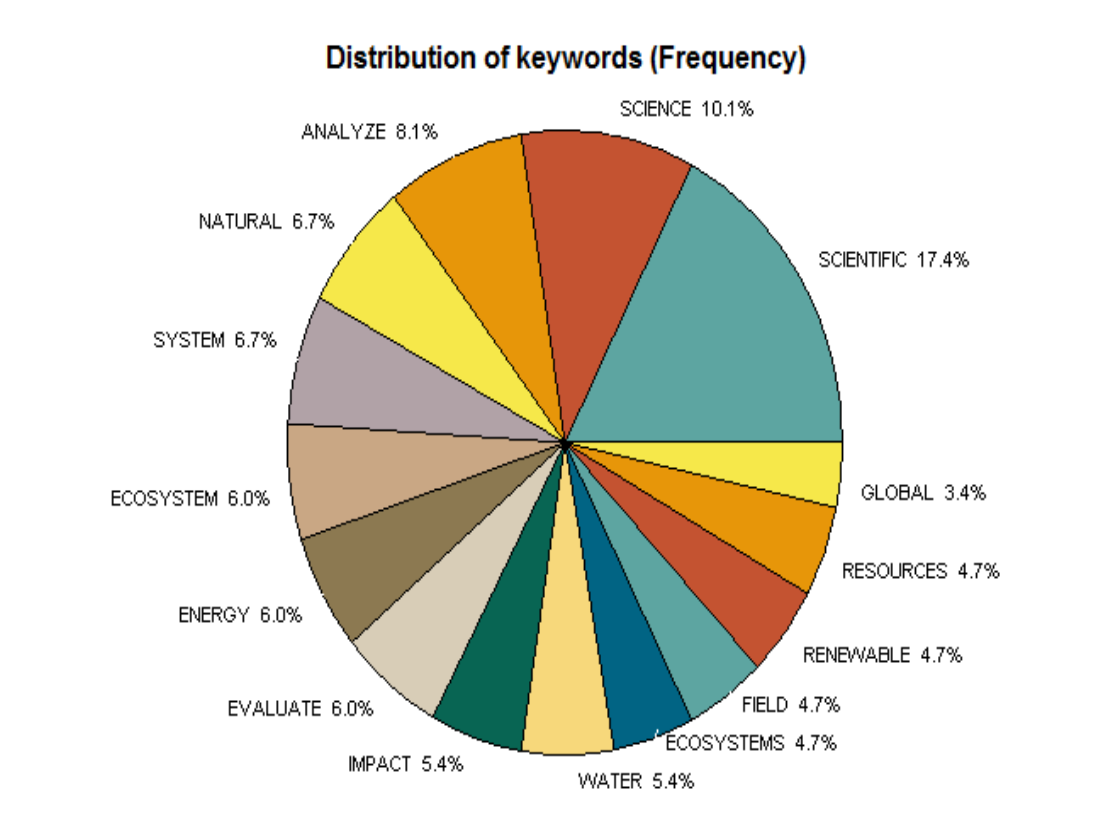
Word frequencies are shown in Figure 13. The most frequent words, *organisms* (21 times), *energy* (18 times) and *ecosystems* (16 times) would indicate that the document be categorized as focusing on ecology. Another frequent word used is

*environment*. Other environmental education terms include *pollution*, *population*, and *resources*, so it does address environmental education to a small extent. *Explanations* (14 times) and *scientific* (12 times) are also high-frequency words and are in the science education processes category. *Evidence* and *explain* are both used eight times and the first ten units of analysis addressed inquiry and the nature of scientific processes. Even with the focus on scientific investigation, analyzing issues, decision-making and action plans are not included in New York standards. It does not strongly address environmental agency. The words *values* and *ethics* were only used once; *principles* and *responsibilities* were not included. In section 1.1c the document states that values are essential to making effective and ethical decisions about the application of scientific knowledge. The word *living* (12 times) was a high-frequency word, as well as *humans* (8 times), *natural* (7 times) and *interdependence*. So these standards do address the category of life supporting even though the main focus of the document is in science education processes and ecology.

### **Texas Essential Knowledge and Skills; Environmental Systems**

The Texas environmental systems education standards have their own section in the state high school science standards along with physics, chemistry, biology, aquatics and earth and space sciences. These standards follow the common outline form of most standards and learner outcomes are generally stated with this phrase: “The student is expected to.” This is followed by a list of learning objectives. These standards begin with science knowledge, skills and processes. The other topics are: biotic and abiotic relationships; resources of the local environmental systems (agriculture, water use,

lumber and waste management); populations and carrying capacity; natural changes in an ecosystem; impact of human activities on the environment; and how ethical beliefs can be used to influence scientific practices.



*Figure 14.* Texas Standards: Top 30 Words Pie Chart

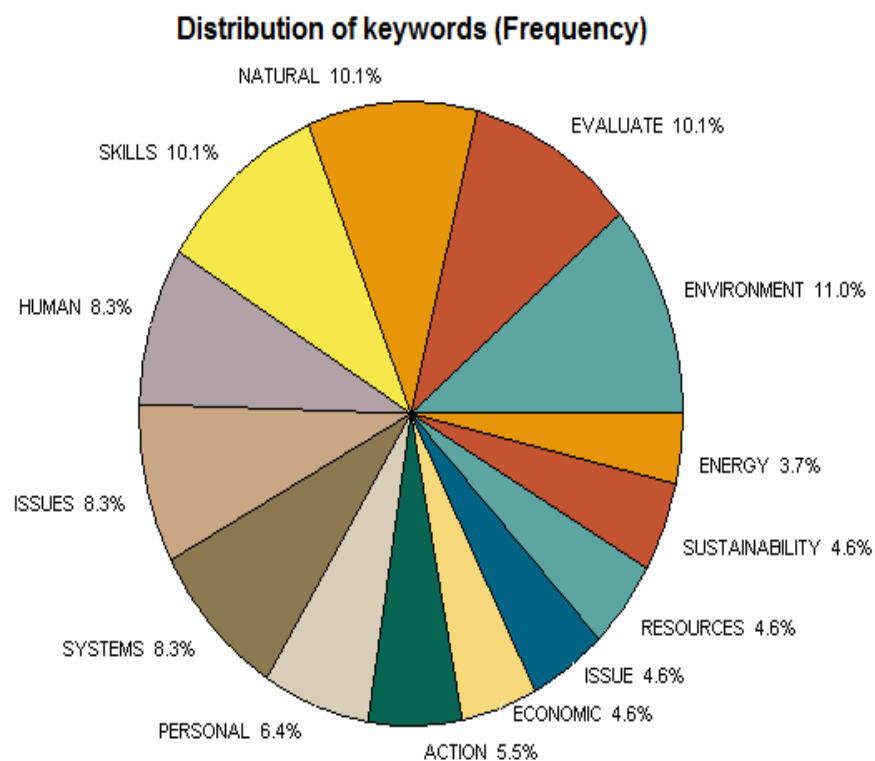


The most frequent words shown in Figure 14 are *scientific* (26 times), *science* (15 times) and *analyze* (12 times). These are science education processes terms. Other high-frequency words are *natural* (10 times), *system* (10 times), *ecosystem* (9 times) and *energy* (9 times). Word frequencies are shown in Figure 3. These terms are in the ecology category. Several objectives include: environmental issues; managing resources; renewable and non-renewable resources and energy sources; and pollution and habitat restoration. Even though there was not a high- frequency of words in the category of environmental education, the document did include these topics. The only use of the word *values* is in reference to recording mathematical *values* with appropriate units, but the word *ethics* or *ethical* is used five times. In one instance, it is used to describe laboratory practices; in another, to describe the impact of technology and research on social ethics and legal practices. The last section of the Texas standards addresses decision- making and societal ethics as these pertain to global warming, organic gardening, legislating and in treaties. The word *sustainability* is used once in reference to conservation of renewable and non-renewable resources, not in terms of future generations. There was no focus on the categories of environmental agency, sustainability eco-values, economics or life supporting.

### **Wisconsin's Model Academic Standards for Environmental Education**

Wisconsin's Model Academic Standards for Environmental Education are found on the state education website and are endorsed by the state superintendent. The format has a content standard, a rationale, and student performance standards for each grade level. The format is different than many of the state standards documents that were

analyzed in that grade levels four, eight and high school are together in each strand. The content standard, rationale, and high school student performance standards were excised from the twenty-four page document for analysis. The five strands are: Questioning and Analysis; Knowledge of Environmental Processes and Systems; Environmental Issue Investigation Skills; Decision and Action Skills; and Personal Civic Responsibility. These are almost identical to the NAAEE strands.



*Figure 15.* Wisconsin Standards: Top 30 Words Pie Chart

Word frequencies are shown in Figure 15. The most frequent words are *environment* (12 times) followed by *evaluate* (11 times) and *natural* (11 times). Each word falls into a different category; environmental education; science education processes; and life supporting. The next most frequent words are *skills*, *human*, *identify*, *issues* and *systems*. These terms are in the science process skills, environmental agency, ecology and life supporting categories. The word *values* is used twice; *sustainable* and *sustainability* are used nine times. *Responsible* and *responsibilities* are used once each. These standards showed a similar coding pattern to the NAAEE guidelines and both reflect a generalized approach to environmental education with terms scattered into most of the categories.

### ***Comparisons of Texts***

#### **Research Question One**

Are sustainability values, as expressed by the international Earth Charter framework for sustainability, implicitly or explicitly present in the NAAEE's Guidelines and AP College Board's Topic Outline for Environmental Science?

The first research question inquires to what extent are sustainability values expressed in the national NAAEE guidelines and AP course description present or frequent in comparison to the international Earth Charter principles. The quantitative coding revealed an implicit alignment with the Earth Charter principles five, six, seven, eight, ten, twelve, fourteen and the NAAEE guidelines. The NAAEE guidelines aligned with more Earth Charter principles than any other document. Second-order dendrograms and proximity plots of the texts showed that the NAAEE guidelines are the most similar

to the Earth Charter than any other of the texts analyzed, even though the similarity of the whole texts was very low. Application of the sustainability eco-values terms as independent variables in the crosstab feature of the Wordstat text mining program showed similarity index of 0.5, which indicates that in the area of sustainability eco-values, the two documents are moderately similar. Considering the NAAEE guidelines rarely use the term *sustainability*, the similarities must occur around the term *values*. The NAAEE guidelines actually had more word occurrences of the thirty terms in the sustainability eco-values dictionary with twenty-three words in the NAAEE guidelines compared to nineteen words in the Earth Charter. Even though the NAAEE guidelines do not promote sustainability values, they do call for learners to examine personal and societal values related to environmental issues. The NAAEE guidelines have a more explicit focus on environmental agency and environmental issues than the Earth Charter, but it barely touches social justice concerns such as gender equality, poverty and racial equality.

There is very little alignment between the Earth Charter and the AP course description. Nearly a third of the units of analysis had no alignment with any of the Earth Charter principles as shown in the quantitative coding of the documents. Some similar topics were covered in the AP course description that were implicitly aligned with Earth Charter principles five, six and seven, but there was essentially no explicit alignment with the Earth Charter. It contained only eleven of the thirty terms in the eco-values dictionary. The AP course description focuses on ecology and environmental education

and is almost devoid of terms related to values, ethics or principles. It does not promote environmental agency.

The NAAEE guidelines and the AP course description cover the Earth Charter principles regarding ecological integrity. The NAAEE guidelines are inclusive of student-centered pedagogies. But neither addresses poverty (principle 9), gender equality (principle 11), strengthening democratic institutions (principle 13) or promoting a culture of tolerance, nonviolence and peace (principle 16). One could argue that wars are waged to obtain resources for unsustainable societies, but certainly it is agreed that destructive military actions drain resources and disrupt communities. Class, gender, race and power shape human interactions with the environment (Cole, 2007). Complex political and social tensions, as well as cultural norms and values, affect the ways people live in their environments and communities (Cole, 2007). For example, neighborhoods with social capital can organize and protest proposals for a landfill or power plant more easily than neighborhoods stricken with poverty. These same tensions and values influence what is emphasized and what is left out of educational discourse and curricula. Prioritizing scientific methodologies excludes other ways of knowing that may help students contextualize, critique and make meaning of the complex interactions between self, others and the environment that are required for a sustainable future (Cole, 2007). Sustainable societies require reflection on how we care for ourselves, each other, other living organisms and the places where we live. In regard to the broader social justice issues encouraged by sustainability values determined by international consensus, the environmental education guidelines are lacking.

## Research Question Two

To what extent do environmental education state standards compare to these national and international guideline documents in expression of the presence, frequency and intensity of sustainability values?

The second research question essentially asks to what extent state standards align with the international and national guidelines. It is very obvious from the crosstab dendrograms and the correspondence graphs how the state documents align with the international and international documents. The Wisconsin and Colorado state standards are aligned with the NAAEE guidelines and the New York and Texas standards align with the AP course description. As shown in Figure 11, the NAAEE group clusters around terms related to environmental agency such as *consequences*, *responsibility* and *action*. The term *values* is more associated with this group than the Earth Charter. The AP group clusters around science terms such as *carrying capacity*, *biodiversity* and *interdependence*. The preferred eco-values term for these documents is *ethics*. The Earth Charter is clustered with terms related to promoting sustainability. The Earth Charter and the California standards are the least aligned with any of the documents and are not aligned with each other.

Similar results occurred in other areas of data collection as the findings are cross-examined. The proximity plots of the documents show that Wisconsin standards and the NAAEE guidelines are the most aligned to each other. This finding is similar to the results of the quantitative coding; Wisconsin had a very similar coding pattern to the NAAEE guidelines. This association was also supported by the crosstab dendrogram

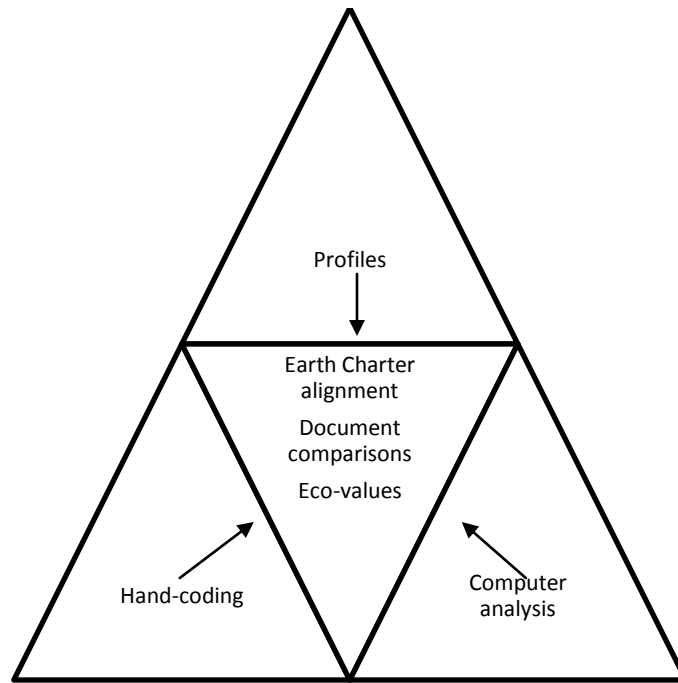
shown in Figure 10 and the correspondence analysis graph shown in Figure 11. The profiles of the documents also show that the NAAEE guidelines and the Wisconsin standards have terms that group in most of the categories; they are both very general and cover many important EE topics and skills. Of the state documents, the Wisconsin and Colorado standards are the most aligned with the Earth Charter, but the similarity is very low. This may be because the NAAEE is most like the Earth Charter and the Wisconsin and Colorado standards are similar to the NAAEE. The NAAEE and the Wisconsin standards do address the examination of personal and societal values.

The quantitative coding pattern of the New York standards, Texas standards and the AP course description are very similar to each other and proximity plots showed that the AP course description and the New York standards are highly aligned to each other. The crosstab dendrogram in Figure 10 showed similarity between these three documents and the correspondence graph. Figure 11, show these three documents clustered in the same quadrant. The proximity plots in Figure 8 and Figure 9 show that the Texas and California standards are the least aligned with the Earth Charter. The quantitative coding showed that one-third of the Texas standards, one-fourth of the California standards and nearly one-third of the AP course description do not align with the Earth Charter. These three documents contained very few of the terms from the eco-values dictionary. The AP course description, the New York and Texas standards all have profiles that focus on ecological and environmental terms and do not address environmental agency. Both the AP and New York standards address sustainability in an implicit manner, but generally do not address eco-values.

There are some interpretations of the data that do not readily corroborate when crosschecked across the different methods of data collection. In the quantitative coding, the Colorado standards text appeared to be an outlier because it had the least alignment with any of the documents analyzed. But the computer analysis showed that the Colorado standards clustered with the NAAEE standards and the California standards were the least similar to any of the standards and appeared to be an outlier. The emphasis on environmental agency found in the Colorado standards is most likely why the documents clustered with the NAAEE. The qualitative profile of the New York standards was not reflected in the computer analysis because the term *sustainability* was not used, even though the document has a section that describes sustainability. Still, generally the interpretations of the findings from several methods of data collection converge on similar conclusions.

Interpretation of findings from multiple data collection sources crosschecks the soundness of the results. The quantitative-coding, qualitative profiling and computer analysis, including word frequencies, clustering, proximity plots and crosstabs comparisons, converge and corroborate the results. A visualization of this process is shown in Figure 16. This methodological triangulation improves the credibility of the investigation (Creswell, 2007).





*Figure 16.* Triangulation of Data Collection Methods

## CHAPTER V

### SUMMARY AND CONCLUSION

If the goal of environmental education is to promote pro-environmental, sustainable behaviors, it has had limited success (Schultz et al., 2004). American citizens have a larger ecological footprint than citizens of any other nation in the world (Jorgenson, 2003; Mostafa, 2010). Coyle's (2005) report card on the environmental literacy of Americans, McBeth and Volk's (2010) national investigation on the environmental literacy of middle school students, and several state studies (Bogan & Kromrey, 1996; Johnson & Smith-Sebasto, 2000; Murphy, 2002) provide evidence that Americans are uninformed and misinformed on many vital ecological processes and environmental concerns. Environmental education is not considered a core subject and is most often an add-on to existing science curricula; yet it has the potential to engage students in authentic local and global environmental activities (Edelson, 2007). Orr (1992) holds the conviction that sustainability education in a world with limited resources is essential for survival and that ecological crisis, in large measure, is a failure of education. Another failure within the current educational system is the prominence of fragmented knowledge taught in a value-free vacuum with no context, leading to apathetic students and low morale among teachers. Environmental education has the potential to offer students a context for integrated, meaningful learning experiences and ignite involvement in the places where they live.

Research on pro-environmental agency indicates that knowledge about the environment is not enough to inspire behavioral changes (Chawla, 2006; Mayer &

Frantz, 2004; Schultz, 2001). There is an affective dimension that arouses action; values are foundational to decision-making and what motivates individuals to take action (Mukherjee, 2005). Therefore, establishing one's values in relationship to the environment and the living organisms that help sustain the system's ability to support life is essential to environmental literacy. What is taught begins with learning criteria established in education standards.

The purpose of this investigation was to examine environmental education standard documents for inclusion of values and the principles of sustainability established by a consensus of the international community. The Earth Charter principles served as the measure for sustainability values. The Earth Charter takes the position that the global economy and societal norms depart dramatically from what is needed to maintain flourishing ecosystems. It could be considered to be a radical document that infuses a biased political perspective that not all Americans would support, especially in science classes. Certainly, inclusion of social justice principles challenges dominant paradigms. Not only is the United States politically entrenched in partisan division, there are still many Americans who do not *believe* in the preponderance of evidence that supports anthropogenic climate change. This is evidenced by conservative cries to *drill, baby drill* and measuring the viability of conservative candidates by their scientific and environmental beliefs.

Achieving sustainable communities entails transforming how people think and feel about the environment as well as changing unsustainable lifestyles. Sustainability will require a change of perspective of the environment from dominating nature to caring

for nature. But the Earth Charter principles go beyond ecological integrity and caring for the environment, to include caring for each other. Economic, racial and gender equality are essential to environmental ethics and flourishing, sustainable communities. More equitable distribution of resources and living within our own resource needs will reduce the need for military action to replenish resources squandered by excessive and wasteful lifestyles. This international consensus document will not achieve consensus among Americans, but reform and transformation require a starting point and target for which to aim. These international consensus values may seem biased and politically charged by some, but the urgency of a looming eco-crisis requires a radical, progressive effort to overcome the inertia of ecological illiteracy and lack of responsibility to future generations.

After environmental standards documents were selected, this content analysis began with a traditional approach of quantitative coding the standards documents for alignment to the Earth Charter principles (Neuendorf, 2002). Computer software that can process large amounts of textual data has improved the ability to examine and compare documents in a more reliable and accurate way (Bechtel, 1997). The Provalis Wordstat6 program was used to quantitatively analyze and compare the texts. A sustainability eco-values dictionary was fashioned based on the literature review and proximity plots of the texts surrounding the terms *values* and *sustainability*. Analysis continued by creating categories or themes to place terms found in the documents analyzed. These categories were used in a qualitative approach to profile each document overall, as well as how each document addressed sustainability values. The detailed and thick descriptions of the

profiles confirmed the findings and added to the trustworthiness of the conclusions. The interpretations of the findings from these three approaches to data collection were then triangulated to improve the credibility of the results.

The first research question asks if the NAAEE guidelines and AP course description express sustainability values as found in the Earth Charter. In the area of ecological integrity, there was similarity, but principles regarding social justice were barely addressed and tended to be implied rather than explicitly stated. The NAAEE includes objectives regarding examination of values and the term *values* was used nine times in the document. The AP course description did not use the terms *values* or *ethics*, but it did include the term *sustainability* and learning topics related to sustainability. The styles and formatting of each of the three documents were very different. The NAAEE guidelines are modeled after other standards documents. The document encourages and STS approach to instruction, integration of subject matter, learning beyond the classroom and environmental agency. The AP course description is, more or less, a list of topics to cover. It is very specific to science and does not endorse pedagogical approaches beyond inquiry. The Earth Charter is a broad statement of actions needed to promote sustainable communities. Generally, the NAAEE guidelines address environmental values and environmental action as expressed in the Earth Charter. It implicitly addresses some economic issues related to social justice, but avoids politically charged social justice issues. Although the AP course description addresses ecological integrity and sustainability, it was very dissimilar to the Earth Charter.

The second research question asked how several state environmental education documents compare to the NAAEE guidelines, the AP course description and the Earth Charter in terms of sustainability values. Clearly, the overall text of the Earth Charter was not very similar to the education documents that were analyzed. The quantitative coding revealed that except for the Colorado standards, all the documents had an implicit alignment with the Earth Charter ecological integrity principles, but excluded the broader environmental justice issues essential for sustainable communities. The quantitative coding showed that California and Texas state standards had the least alignment with the Earth Charter; the computer generated dendrograms supported this finding. California contained only six words from the eco-values dictionary; Texas contained only nine and these were peripheral words such as resources and biodiversity. The documents did group together in very definite clusters. The NAAEE, Wisconsin and Colorado documents clustered in one group, the AP, New York and Texas documents formed another group. The Earth Charter and California documents each were dissimilar to the other documents and did not group with other texts. This was shown in similar patterns in the quantitative coding, dendrograms, proximity plots, correspondence analysis and document profiles.

The crosstab analysis showed that the NAAEE guidelines, Wisconsin standards and Colorado standards have a high correlation with terms such as: *values, beliefs, action, behaviors* and *responsibility*. These three documents also explicitly address examination of personal and societal values. The qualitative examination of the text revealed that the AP course description and the New York state standards have some

emphasis on sustainability, the recognition that resources are finite and that humans have an important impact on ecosystems. The New York standards did include fourteen of the eco-value dictionary terms. So, the NAAEE, Colorado standards, Wisconsin standards, AP course description and the New York standards do address sustainability issues. The NAAEE, Colorado and Wisconsin standards explicitly emphasize environmental issue-analysis, environmental agency and examination of personal environmental values. The NAAEE guidelines and the Colorado standards even include the notion of place and its importance in human identity. This not only encourages learning locally, it addresses the concerns of nature-deficit among young people. Even though these documents do not explicitly address all the social justice issues included in the Earth Charter, they do strive to prepare students to address the local and global issues that will confront them in the future.

The third research question asked what the dominant discourse of each document is. Qualitative categories were generated from the text and word frequencies, which were used to profile the documents. The Earth Charter is a call to action for sustainable behaviors and contains the international consensus of life-affirming, humanistic values. The majority of terms in the document are in the categories of sustainability eco-values and life-supporting. The NAAEE guidelines and the Wisconsin state standards present a generalized approach with terms scattered in most categories, but with a focus on science education processes, environmental agency and ecology. The AP course description suggests the importance of sustainability, but the document focuses on the categories of ecology and environmental education. The embedded

California standards terms fall under the categories of ecology and science education processes. The Colorado standard terms tend to be in the categories of general education and environmental agency. The majority of high frequency terms in the embedded New York standards are in the science education processes and ecology categories. The New York standards do have objectives that address sustainability and terms from those objectives fall into the life-supporting category. The terms from the Texas standards focus on ecology and science education processes such as inquiry. Texas standards address sustainability from a resource management perspective rather than a perspective that is concerned about sustainability for future generations.

The implication by some post-modern environmental education commentators is that in creating standards documents, environmental education is complying with norms that are contrary to the transformative goals of environmental education (Greenwood, et al., 2009; Gruenewald, 2004; Wals & van der Leih, 1997). Simmons (2000), who was a central figure in the creation of the NAAEE guidelines, claims that the guidelines were carefully crafted to gain acceptance among the educational establishment, yet still include essential components of environmental literacy. Without acceptance by the educational community that is driven by standards and accountability, learners will have even less exposure to environmental education. The emphasis of the NAAEE guidelines on critical issue-analysis, civic responsibility, as well as exploration of personal and societal values can be endorsed by most environmental educators and educators in general (Disinger, 2001). The NAAEE guidelines and Wisconsin's model standards are not devoid of values, but lay the foundation for learners to develop pro-environmental



values through awareness and experience in civic decision-making and participation. Using these guidelines for state standards would surely advance environmental literacy that is inclusive of environmental agency and sustainability values. Although the AP course description is limited to scientific topics, they have lent credibility to the study of ecology, environmental science and sustainability in American schools.

The NAAEE guidelines, Wisconsin state standards and Colorado standards explicitly address environmental values, but Wisconsin and Colorado are not as highly populated as the other states in this study. The environmental education state standards from states with the highest populations are California, Texas and New York and these documents do not explicitly address environmental values. The present study showed these state standards tend to be science topic-driven similar to the AP course description. In addition, California, Texas and New York standards focus exclusively on scientific inquiry as a pedagogical approach rather than the STS, issue analysis and environmental agency approach of the NAAEE, Wisconsin and Colorado documents. If inclusion of environmental education in high schools is rationalized by the existence of AP environmental education opportunities, then it would follow that state standards would be based on the AP course description rather than the NAAEE guidelines. Although the AP course description includes objectives related to sustainability, it presents a rather one-dimensional approach to a socio-cultural, economic, political and ecological topic. If state environmental education learning objectives are based on the AP course description, environmental values and the integrated approach to environmental education supported by the literature may not be explicitly addressed.

The most likely candidate that will influence the state of environmental education in the United States, as well as science education in general, is the Next Generation Science Standards that the National Research Council is preparing to release in the summer of 2011. Within these standards, environmental science will be embedded in the life and earth science objectives, so it is unlikely that the Next Generation Science Standards will promote environmental education as a core subject. The integrated approach to environmental education offered by the NAAEE will not likely be included in objectives aimed at science education reform. As long as environmental education is seen simply as an add-on to science objectives, the socio-cultural, justice issues will not be addressed in public high schools. The integrated approach promoted by the NAAEE guidelines, Wisconsin and Colorado standards are more inclusive of social issues than the AP and its cluster of state standards.

Some may argue that social and ecological justice is not a concern of science educators and politics does not have a place in the classroom. Covering the existing overstuffed curriculum to meet accountability requirements leaves little time for eco-justice discourse. Policy gatekeepers may not even allow the inclusion the politically charged progressive ideology promoted by the Earth Charter. Forcing the issue may close the gate. In the current political climate, compromise is necessary to gain entry into the educational system. Environmental education cannot achieve its transformative potential if it is never taught in schools. But to work toward this transformative potential, environmental educators should continue to expand the discourse around critical social justice issues of class, race, gender and power (Cole, 2007). Adopting the NAAEE

guidelines is a step in the right direction, but the NAAEE does not have the influential power on educational policy-makers of the AP organization or the National Research Council. The integrated nature of the NAAEE guidelines' approach to environmental education does not fit into existing school structure. Without core status, environmental education may not achieve its goals of addressing knowledge, values, attitudes and practical skills to participate in responsible and effective ways to solve environmental problems. An optimistic view would see the potential in utilizing local environmental investigations as an avenue for school reforms that integrate subject matter in more authentic student-centered approaches to education. When science, social studies, language arts and math are integrated as suggested by the NAAEE guidelines, addressing social justice issues would be more appropriate than in a dedicated science laboratory class.

### **Limitations of the Study**

Although assessing the presence or absence of terms and the frequency of terms is a simple matter of counting words, interpreting the meaning of the text is subjective. From a postmodern perspective, bias of the researcher can be lessened, but not totally eliminated. Because of the lack of scientific expertise among the coders, I may have had a greater influence than coders with greater scientific knowledge. During coding discussions, I may have influenced the coders in an attempt to achieve consensus. Using the Earth Charter as a standard against which to rate instead of a codebook, did not allow for adaption of the coding process. In addition, the inter-rater reliability was acceptable at a Cohen's alpha of 0.53, but it was not as high as preferred. There was difficulty in

assessing whether units of analysis were explicit or implicit. But careful review of the data through triangulation assisted in achieving more accurate and trustworthy conclusions.

Comparing science course standards to the Earth Charter, an international document which expresses fundamental principles for building a just, sustainable, and peaceful global society in the 21st century, may also be a limitation. The political nature of the Earth Charter and its inclusion of social justice issues go beyond the scope of science class. The literature supports an integrated approach to environmental education and standards embedded in science laboratory courses are specific to ecological and environmental science objectives rather than inclusive of the broader social and economic concerns of environmental studies. The focus of a science course would more likely be related to knowledge and awareness rather than values associated with the affective domain. In addition, the Earth Charter was created during the 1990's and it may be dated although the ecological integrity principles portray science that is still accurate today in the second decade of the 21<sup>st</sup> century. Selection of which state standards to examine was not random and perhaps only stand-alone environmental education standards should have been examined, but this would have excluded the high population states of New York and California. In addition, although standards reflect what should be taught, what and how teachers actually teach can only be accurately assessed by direct observation.

## **Future Research**

Comparison of other nations' environmental standards to the Earth Charter and to the NAAEE guidelines would be a logical next step for this line of research. The national standards for environmental education in several countries such as Canada, Australia, New Zealand and Great Britain are readily available online. Comparisons of more state standards to the NAAEE guidelines and the AP course descriptions would be useful in creating a more practical and general picture of how environmental education is implemented in the United States. Social studies standards could be included to gain a more holistic understanding of the socio-cultural aspects of environmental education. Perhaps social studies issues would have some alignment with the environmental justice issues not found in environmental science courses. Differences between states that have environmental education standards that are not embedded in life and earth science standards could be compared to states that embed environmental objectives. In addition, the Next Generation of Science Standards will be released in the summer of 2011. If this national document becomes as influential and pervasive as the Language Arts and Math standards, a content analysis of this document may be predictive of how environmental education will be taught in the future. Moving beyond the content analysis approach to a more experimental approach, environmental literacy could be measured and comparisons between states could be conducted. These measurements could be associated with environmental educational approaches endorsed by state standard documents. Environmental science classes could be observed to see how instructors are actually implementing standards and environmental education approaches.

## **Conclusion**

There is substantial evidence that the habits of developed nations are having a significant negative effect on the long-term availability of limited resources and, perhaps, on the viability of the environment to continue to support a quality of life for all organisms (UNESCO, 2005). The energy-needs essential to modern lifestyles are built on unsustainable resources that may be undermining the ability of our very thin atmosphere to maintain homeostasis. Agribusinesses utilize the same non-renewable resources to chemically-enhance food production, yet ignore the long-term health of the soil. Fresh, unpolluted water may be the most limited and endangered resource yet our waterways are treated like toilets and precious water resources out west are squandered on golf courses, swimming pools and decorative fountains. So many people seem to be unaware of the environmental consequence of their everyday actions and simply flow along with the mainstream social norms of their neighbors.

It seems to me that Americans enjoy a history of rugged individuals who conquered, tamed and devoured the gifts of nature. Our current world is surrounded in advertising; there are television commercials, print ads, ads on websites, and billboards, all of which encourage consumerism. These two types of lifestyles that portray citizenship in our developed nation are unsustainable, yet these underlie the values that drive most people's behaviors. Cultural values and environmental awareness drive the decisions each person makes regarding their resource consumption. Sustainability values include social justice concerns because caring communities embrace equitable resource distribution and affirm responsibility to all community members. For sustainable values

to become the norm for our culture, citizens must learn to value, respect and take action to protect ecosystems that support life on the planet. People must be taught that the environment is a relationship between humanity and the impact our resource needs have on each other and life-sustaining ecosystems.

The Earth Charter sustainability principles were not shown by the present study to have an appreciable influence on environmental education standards, but the NAAEE guidelines are the most similar of all the documents analyzed to the values promoted in the Earth Charter. The NAAEE guidelines inclusion of values and the state standards that are modeled on it are a beginning and allow educators the space to include environmental literacy and sustainability values concerns in educational discourse. Unfortunately, the present study demonstrates that the most highly populated states do not base their environmental education standards on the NAAEE guidelines and do not explicitly address environmental values or environmental agency.

Environmental education contrasts with the goal of schooling which is to conserve existing cultural norms and values (Stevenson, 2007). Achieving the environmental education goals of knowledge, values, attitudes and pro-environmental behaviors are problematic because values that underlie environmental degradation must be transformed to values that support sustainable communities. Schooling is discipline-based and focused on pre-determined specific learning objectives that are easily assessed, but environmental education should be interdisciplinary and focused on real world problem-solving (Stevenson, 2007). The best approach to environmental

education requires reform of an entrenched educational system, which is a very difficult proposition.

The present study presents a rather pessimistic outlook for top-down, standards-based changes in approaches to environmental education and its status as a core subject. Perhaps a more optimistic view can be found in local, grassroots efforts in addressing the problems of lack of environmental literacy, lack of nature connection and lack of environmental values. As momentum gathers in favor of sustainability values, parents, students and educators can influence local districts in a bottom up approach. After all, school decisions are traditionally given over to local control. Dedicated environmental educators across the country are creating place-based programs and connecting their students with local communities (Sobel, 2004). The Children and Nature Network, The Orion Society, High Adventure Scouts and other local organizations are supporting educators and parents in these efforts. Environmental education may be a long way from achieving its goals, but long-term thinking is the hallmark of environmentalists. Achieving environmental literacy that is inclusive of sustainability values is the first step on the long journey to changing lifestyles and creating ethical, sustainable societies that meet responsibilities to future generations.



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## APPENDIX A

### EARTH CHARTER PRINCIPLES

#### I. RESPECT AND CARE FOR THE COMMUNITY OF LIFE

**1. Respect Earth and life in all its diversity.**

- a. Recognize that all beings are interdependent and every form of life has value regardless of its worth to human beings.
- b. Affirm faith in the inherent dignity of all human beings and in the intellectual, artistic, ethical, and spiritual potential of humanity.

**2. Care for the community of life with understanding, compassion, and love.**

- a. Accept that with the right to own, manage, and use natural resources comes the duty to prevent environmental harm and to protect the rights of people.
- b. Affirm that with increased freedom, knowledge, and power comes increased responsibility to promote the common good.

**3. Build democratic societies that are just, participatory, sustainable, and peaceful.**

- a. Ensure that communities at all levels guarantee human rights and fundamental freedoms and provide everyone an opportunity to realize his or her full potential.
- b. Promote social and economic justice, enabling all to achieve a secure and meaningful livelihood that is ecologically responsible.

**4. Secure Earth's bounty and beauty for present and future generations.**

- a. Recognize that the freedom of action of each generation is qualified by the needs of future generations.
- b. Transmit to future generations values, traditions, and institutions that support the long-term flourishing of Earth's human and ecological communities.

In order to fulfill these four broad commitments, it is necessary to:

#### II. ECOLOGICAL INTEGRITY

**5. Protect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain life.**

- a. Adopt at all levels sustainable development plans and regulations that make environmental conservation and rehabilitation integral to all development initiatives.
- b. Establish and safeguard viable nature and biosphere reserves, including wild lands and marine areas, to protect Earth's life support systems, maintain biodiversity, and preserve our natural heritage.
- c. Promote the recovery of endangered species and ecosystems.

- d. Control and eradicate non-native or genetically modified organisms harmful to native species and the environment, and prevent introduction of such harmful organisms.
- e. Manage the use of renewable resources such as water, soil, forest products, and marine life in ways that do not exceed rates of regeneration and that protect the health of ecosystems.
- f. Manage the extraction and use of non-renewable resources such as minerals and fossil fuels in ways that minimize depletion and cause no serious environmental damage.

**6. Prevent harm as the best method of environmental protection and, when knowledge is limited, apply a precautionary approach.**

- a. Take action to avoid the possibility of serious or irreversible environmental harm even when scientific knowledge is incomplete or inconclusive.
- b. Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm.
- c. Ensure that decision making addresses the cumulative, long-term, indirect, long distance, and global consequences of human activities.
- d. Prevent pollution of any part of the environment and allow no build-up of radioactive, toxic, or other hazardous substances.
- e. Avoid military activities damaging to the environment.

**7. Adopt patterns of production, consumption, and reproduction that safeguard Earth's regenerative capacities, human rights, and community well-being.**

- a. Reduce, reuse, and recycle the materials used in production and consumption systems, and ensure that residual waste can be assimilated by ecological systems.
- b. Act with restraint and efficiency when using energy, and rely increasingly on renewable energy sources such as solar and wind.
- c. Promote the development, adoption, and equitable transfer of environmentally sound technologies.
- d. Internalize the full environmental and social costs of goods and services in the selling price, and enable consumers to identify products that meet the highest social and environmental standards.
- e. Ensure universal access to health care that fosters reproductive health and responsible reproduction.
- f. Adopt lifestyles that emphasize the quality of life and material sufficiency in a finite world.

**8. Advance the study of ecological sustainability and promote the open exchange and wide application of the knowledge acquired.**

- a. Support international scientific and technical cooperation on sustainability, with special attention to the needs of developing nations.
- b. Recognize and preserve the traditional knowledge and spiritual wisdom in all cultures that contribute to environmental protection and human well-being.
- c. Ensure that information of vital importance to human health and environmental protection, including genetic information, remains available in the public domain.

### III. SOCIAL AND ECONOMIC JUSTICE

#### **9. Eradicate poverty as an ethical, social, and environmental imperative.**

- a. Guarantee the right to potable water, clean air, food security, uncontaminated soil, shelter, and safe sanitation, allocating the national and international resources required.
- b. Empower every human being with the education and resources to secure a sustainable livelihood, and provide social security and safety nets for those who are unable to support themselves.
- c. Recognize the ignored, protect the vulnerable, serve those who suffer, and enable them to develop their capacities and to pursue their aspirations.

#### **10. Ensure that economic activities and institutions at all levels promote human development in an equitable and sustainable manner.**

- a. Promote the equitable distribution of wealth within nations and among nations.
- b. Enhance the intellectual, financial, technical, and social resources of developing nations, and relieve them of onerous international debt.
- c. Ensure that all trade supports sustainable resource use, environmental protection, and progressive labor standards.
- d. Require multinational corporations and international financial organizations to act transparently in the public good, and hold them accountable for the consequences of their activities.

#### **11. Affirm gender equality and equity as prerequisites to sustainable development and ensure universal access to education, health care, and economic opportunity.**

- a. Secure the human rights of women and girls and end all violence against them.
- b. Promote the active participation of women in all aspects of economic, political, civil, social, and cultural life as full and equal partners, decision makers, leaders, and beneficiaries.
- c. Strengthen families and ensure the safety and loving nurture of all family members.

#### **12. Uphold the right of all, without discrimination, to a natural and social environment supportive of human dignity, bodily health, and spiritual well-being, with special attention to the rights of indigenous peoples and minorities.**

- a. Eliminate discrimination in all its forms, such as that based on race, color, sex, sexual orientation, religion, language, and national, ethnic or social origin.
- b. Affirm the right of indigenous peoples to their spirituality, knowledge, lands and resources and to their related practice of sustainable livelihoods.
- c. Honor and support the young people of our communities, enabling them to fulfill their essential role in creating sustainable societies.
- d. Protect and restore outstanding places of cultural and spiritual significance.

#### **IV. DEMOCRACY, NONVIOLENCE, AND PEACE**

##### **13. Strengthen democratic institutions at all levels, and provide transparency and accountability in governance, inclusive participation in decision making, and access to justice.**

- a. Uphold the right of everyone to receive clear and timely information on environmental matters and all development plans and activities which are likely to affect them or in which they have an interest.
- b. Support local, regional and global civil society, and promote the meaningful participation of all interested individuals and organizations in decision making.
- c. Protect the rights to freedom of opinion, expression, peaceful assembly, association, and dissent.
- d. Institute effective and efficient access to administrative and independent judicial procedures, including remedies and redress for environmental harm and the threat of such harm.
- e. Eliminate corruption in all public and private institutions.
- f. Strengthen local communities, enabling them to care for their environments, and assign environmental responsibilities to the levels of government where they can be carried out most effectively.

##### **14. Integrate into formal education and life-long learning the knowledge, values, and skills needed for a sustainable way of life.**

- a. Provide all, especially children and youth, with educational opportunities that empower them to contribute actively to sustainable development.
- b. Promote the contribution of the arts and humanities as well as the sciences in sustainability education.
- c. Enhance the role of the mass media in raising awareness of ecological and social challenges.
- d. Recognize the importance of moral and spiritual education for sustainable living.

##### **15. Treat all living beings with respect and consideration.**

- a. Prevent cruelty to animals kept in human societies and protect them from suffering.
- b. Protect wild animals from methods of hunting, trapping, and fishing that cause extreme, prolonged, or avoidable suffering.
- c. Avoid or eliminate to the full extent possible the taking or destruction of non-targeted species.

##### **16. Promote a culture of tolerance, nonviolence, and peace.**

- a. Encourage and support mutual understanding, solidarity, and cooperation among all peoples and within and among nations.
- b. Implement comprehensive strategies to prevent violent conflict and use collaborative problem solving to manage and resolve environmental conflicts and other disputes.
- c. Demilitarize national security systems to the level of a non-provocative defense posture, and convert military resources to peaceful purposes, including ecological

restoration.

d. Eliminate nuclear, biological, and toxic weapons and other weapons of mass destruction.

e. Ensure that the use of orbital and outer space supports environmental protection and peace.

f. Recognize that peace is the wholeness created by right relationships with oneself, other persons, other cultures, other life, Earth, and the larger whole of which all are a part.

## APPENDIX B

### STATES WITH FORMAL EE LEARNER OBJECTIVES

From: <http://www.fundee.org/campaigns/nclb/brief5b.htm>

State	Details
Arkansas	Department of Education Benchmarks
California	See the Education and the Environment state plan document. <a href="http://www.cde.ca.gov">www.cde.ca.gov</a> This document is no longer at this site
Florida	Teaching Naturally/ Florida Sunshine State Standards ( <a href="http://www.firn.edu/doe/curriculum/environ/teaching_naturally.html">www.firn.edu/doe/curriculum/environ/teaching_naturally.html</a> )
Iowa	Each district must have its own standards showing how the Iowa Admin Code is met.
Illinois	Illinois State Board of Education Illinois Learning Standards and Green Standards ( <a href="http://www.isbe.net/ils/">www.isbe.net/ils/</a> )
Kansas	Kansas Department of Education website has non-tested ee standards including objectives and outcomes listed on their website; so does the KACEE website ( <a href="http://www.kacee.org">www.kacee.org</a> )
Massachusetts	'Benchmarks On the Way to Environmental Literacy' K-12 <a href="http://www.eetap.org/media/pdf/Benchmark.pdf">www.eetap.org/media/pdf/Benchmark.pdf</a>
Maryland	
Minnesota	Three statutes related to environmental education in the Waste Management Act (Chapter 115A). <a href="http://www.seek.state.mn.us/eemn_g.cfm">www.seek.state.mn.us/eemn_g.cfm</a>
Montana	In progress
New Jersey	NJ's revised science and social studies core curriculum content standards include an environmental studies standard in science and a geography/environmental standard in social studies, both for grades K-12. ( <a href="http://www.nj.gov/njded/aps/">www.nj.gov/njded/aps/</a> ) standards available at DOE home page.
New Mexico	Instructional Strategies for the Implementation of NM Content Standards and Benchmarks. Science Content Standards include Environmental Science, not other subjects, at <a href="http://www.doe.nv.gov/sca/standards/standardsfiles/science/index.html">www.doe.nv.gov/sca/standards/standardsfiles/science/index.html</a>
Ohio	There are no specific standards for EE, however there are strong EE related indicators that are embedded in the Science, Social Studies and Technology as well as in English, language arts, and math academic standards. EL Connections Focus Group <a href="http://www.okcel.org">www.okcel.org</a>
Pennsylvania	PA has a matrix by grade category which gives examples of what a student should know at what grade level related to the EE

	standards. ( <a href="http://www.state.pa.us">www.state.pa.us</a> keywords: academic standards)
Texas	TEA web site - Texas Essential Knowledge and Skills
Washington	Pacific Education Institute Technical Report 1 and 2
Wisconsin	Wisconsin's Model Academic Standards for Environmental Education. <a href="http://www.dpi.state.wi.us/standards/index.html">www.dpi.state.wi.us/standards/index.html</a>
West Virginia	WV Science Content Standards, WV Department of Education. <a href="http://wvde.state.wv.us">http://wvde.state.wv.us</a> (look under CSOs ex. SC.3.4.3)

## APPENDIX C

### STATE STANDARDS AS ENTERED INTO WORDSTAT

#### California

##### Ecology

6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:
  - a. Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
  - b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
  - c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.
  - d. Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.
  - e. Students know a vital part of an ecosystem is the stability of its producers and decomposers.
  - f. Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.
  - g.\* Students know how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.

##### Energy in the Earth System

4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:
  - a. Students know the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.
  - b. Students know the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
  - c. Students know



the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect. d.\* Students know the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.

### **Biogeochemical Cycles**

7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept:
  - a. Students know the carbon cycle of photosynthesis and respiration and the nitrogen cycle.
  - b. Students know the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.
  - c. Students know the movement of matter among reservoirs is driven by Earth's internal and external sources of energy. d.\* Students know the relative residence times and flow characteristics of carbon in and out of its different reservoirs.

### **Investigation and Experimentation** □

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
  - a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
  - b. Identify and communicate sources of unavoidable experimental error.
  - c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
  - d. Formulate explanations by using logic and evidence.
  - e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
  - f. Distinguish between hypothesis and theory as scientific terms.

- g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
- h. Read and interpret topographic and geologic maps.
- i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
- j. Recognize the issues of statistical variability and the need for controlled tests.
- k. Recognize the cumulative nature of scientific evidence.
- l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
- m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
- n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

## Colorado

### 1.1 Questioning, Analysis and Interpretation Skills

Developing environmental literacy depends on a willingness and ability to ask questions about the surrounding world, speculate and hypothesize, seek and evaluate information, and develop answers to questions. Environmental educators understand and can communicate the processes of investigation; and design, conduct, and evaluate such investigations.

- Model the basic modes of inquiry and application of environmental investigations in instruction.
- Ask questions and state hypotheses, using prior knowledge to help guide the development of environmental awareness and investigations of various types.
- Create a written plan for scientific investigations.
- Create opportunities for experiences to answer particular questions about the environment.

- Collect information by selecting and using appropriate technologies to gather, process, and analyze data and to report information related to an investigation.
- Organize and display information in ways appropriate to different types of environmental investigations and purposes. Work with models and simulations.
- Construct and revise explanations and models using evidence, logic, and experiments that include identifying and controlling variables.
- Evaluate accuracy and reliability of explanations and models to identify major sources of error or uncertainty within an investigation (e.g., particular measuring devices and experimental procedures).
- Communicate new understandings.

### **1.2 Knowledge of Environmental Processes and Systems**

Environmental literacy hinges on understanding the processes and systems that comprise the environment, including human social systems and their influences. That understanding is based on knowledge synthesized from across the traditional disciplines (especially the natural and social sciences) and includes knowledge about:

- Processes and interactions of Earth's systems and the structure and dynamics of Earth, including how physical processes shape Earth's surface patterns and systems.
- Characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment, including the interrelationships of matter and energy in living systems and how organisms change over time in terms of biological evolution and genetics.
- Physical and human characteristics of places, and how to use this knowledge to define and study individuals, groups, and regions and their patterns of change. Knowledge of how culture and experience influence people's perceptions of places and regions.
- Environment and society including human/environment interactions; effects and patterns of human populations and how the population affects all aspects of the environment.
- Effects of interactions between environmental systems (including human and physical) and the changes in meaning, use, distribution, and importance of resources.

### **1.3 Processes of Addressing Environmental Issues**

Environmental educators understand that environmental literacy includes the abilities to research, evaluate, and act on environmental issues. The skills and knowledge outlined in the first two guidelines are applied and refined in the context of these issues.

For example:

- Be familiar with monitoring techniques to collect data about environmental problems.
- Describe appropriate questions for determining whether or not action on an issue is warranted.
- Understand and participate in the decision-making process.

- Apply research skills to determine attitudes, beliefs, and values held by different stakeholders involved with an issue.
- Analyze and evaluate the influence of various forms of individual action on an environmental issue.
- Explore and analyze the causes, consequences, and possible solutions to persistent, contemporary, or emerging environmental issues.
- Identify and implement strategies for preventing or resolving environmental issues.

#### **1.4 Personal and Civic Responsibility**

Environmental educators understand how people exercise the roles, rights and responsibilities of participation in civic life at all levels - local, state, and national.

For example:

- Understand the process of creating regulations related to environmental quality.
- Identify and exercise individual rights and responsibilities.
- Describe the nature of environmental issues and the role of beliefs and values.
- Be involved in responsible environmental behaviors: persuasion, consumer/economic, political, legal, direct intervention/eco-management, etc.
- Be familiar with research about the best predictors of responsible environmental behavior.
- Use models of teaching responsible environmental behavior (e.g., case study, issue investigation, sharing of personal experiences).

#### **1.5 Environmental Sensitivity**

Environmental educators understand the importance and facilitate the development of environmental sensitivity – one's connection to and awareness of the natural world - in fostering environmentally literate behavior.

For example:

- Describe variables influencing development of environmental sensitivity (e.g., time spent outdoors, reading environmental literature, role models, development of an ecological identity).
- Be familiar with the relative importance of environmental sensitivity variables in predicting responsible environmental behavior.
- Describe experiences that can influence development of environmental sensitivity (i.e., educational experiences, personal impressions, intuitions and feeling responses).

- Use a variety of methods that can influence development of environmental sensitivity, for example: outdoor education, environmental literature and art, experiences with environmental role models and sense of place principles.

## Foundations of Environmental Education

### 2.1 Fundamental Characteristics and Goals of Environmental Education

Environmental educators understand environmental education as a distinct field and know its defining characteristics and goals.

For example:

- Identify the goals and objectives of environmental education as laid out in founding documents of the field, such as the Belgrade Charter (UNESCO-UNEP, 1976) and Tbilisi Declaration (UNESCO, 1978), as well as in more recent definitions such as Agenda 21 (UNCED, 1992).
- Know about the goals and objectives for environmental education in Colorado as described in the 2005 Colorado Environmental Education Master Plan.
- Describe the broad view that environmental education takes of “environment,” incorporating concepts such as systems, interdependence, and interactions among humans, other living organisms, the physical environment, and the built or designed environment.
- Characterize environmental education as an interdisciplinary field and provide examples of ways in which it draws on and integrates knowledge and skills from across different subjects.
- Understand how environmental education's focus on environmental literacy relates to the need to provide opportunities for learners to move from awareness to informed action.
- Recognize environmental education as a tool toward environmental stewardship.

### 2.2 How Environmental Education is Implemented

Environmental educators understand that environmental education encompasses a variety of settings, audiences, providers, and methods and that sources of support, program requirements, and other factors vary from context to context. For a statewide listing of environmental education programs and resources, visit CAEE’s online database/directory at [www.caee.org](http://www.caee.org).

For example:

- Identify individuals, organizations, and agencies delivering formal and nonformal environmental education programs.
- Be familiar with national, regional, state, and local environmental education programs and support services, including funding sources and resources.
- Identify efforts to link formal education and nonformal programs through partnerships and collaborations.
- Understand how school policies, state or local mandates, and federal legislation influence environmental education efforts.
- Describe ways in which environmental education supports education reform goals.

- Identify environmental education's role in professional development and continuing education experiences.
- Describe how different methods of environmental education fit into the overall goal of developing responsible environmentally literate individuals.

### **2.3 The Evolution of the Field of Environmental Education**

Environmental educators are familiar with the growth of the field of environmental education. For example:

- Discuss how various educational and social movements have contributed to the development of the field of environmental education. Identify how these movements differ from environmental education, and discuss their influence today.

Examples of these movements include: education-based (natural history, outdoor education, conservation education, ecology education, challenge/adventure education and inquiry-based), social and cultural awareness (recreation, Native American Heritage, and environmental justice) and environmental (watershed approach, human health, and sustainability).

- Discuss how the work of bodies such as the Brundtland Commission (Brundtland, 1987), the United Nations Conference on Environment and Development (UNCED, 1992), the International Conference on Environment and Society (UNESCO 1997), and the World Summit on Sustainable Development (2002) has influenced—or might influence— environmental education. Other works to discuss include Environmental Protection Agency's report on Environmental Justice, Agenda 21, Earth and Faith and work from the National Science Teacher Association (NSTA).
- Identify current and emerging issues in the field of environmental education. For example, evaluate assertions that environmental education focuses more on advocacy rather than education and discuss how these assertions are affecting environmental educators and education programs. Other examples might include: reduction of content with field-based work, scientific accuracy of EE instruction, liability, and evaluation and assessment.

- Discuss how current educational reform in related fields shape and support current practices in environmental education (i.e., NSTA standards, National Resource Council Standards, No Child Left Behind, CSAP, etc.).
- Discuss past and current research findings from environmental education and their effect on how environmental education might be perceived, defined, or practiced.
- Understand and appreciate the historical events in environmental education in Colorado. A historical perspective allows one to identify trends and cycles.

## Professional Responsibilities of the Environmental Educator

### 3.1 Emphasis on Education, Not Advocacy

Environmental educators provide accurate, objective, balanced, and effective instruction that acknowledges different views and opinions about environmental conditions, issues or actions.

For example:

- Identify and implement instructional techniques to present differing viewpoints and theories in a balanced manner and identify potential sources of bias in information.
- Differentiate among instructional materials on the basis of their factual accuracy. Select and use materials that together present a range of differing viewpoints and interpretations where there are differences of opinion or competing scientific explanations.
- Weigh evidence regarding environmental problems based on validity and reliability of research (e.g., from scientific societies or reputable journals).
- Identify and implement instructional strategies and techniques that encourage learners to explore different perspectives and form and explain their own opinions.

### 3.2 Ongoing Learning and Professional Development

Environmental educators are active learners in their professional lives.

For example:

- Continually update and expand existing knowledge and information about the environment and related issues, current research, environmental education materials, and instructional methods. For example, critically read scientific journals or actively participate in local, state, national, or international organizations associated with environmental education, or participate in a professional certification program.
- Develop professional relationships with mentors, advisors, and others to expand and upgrade knowledge, skills, and understanding of differing points of view about environmental issues.

- Reflect on and learn from personal practice as an environmental educator, both individually and with other professionals and colleagues. Use tools such as peer coaching, portfolios, and journals.
- Seek out opportunities to learn essential content and skills in real-world environmental settings or contexts, especially within the communities and ecosystems in which one lives and teaches.

## Planning and Implementing Environmental Education

### 4.1 Knowledge about Learners and Learning

Environmental educators tailor instructional approaches to meet the needs of different learners in an engaging and challenging way. Whenever possible, accommodations for learners with special needs will be made.

For example:

- Model methods for presenting the environment or environmental issues in appropriate and engaging ways for learners of different ages, genders, backgrounds, levels of knowledge, and developmental abilities. (This range may include adults, especially for educators in nonformal settings.)
- Select environmental education materials and strategies that are developmentally appropriate and adjust these in response to individual differences among learners.
- Demonstrate an understanding of different learning and cognitive styles and the idea of multiple intelligences to reach all learners.
- Recognize and acknowledge varying socio-cultural perspectives present in groups of learners and tailor instructional approaches to respond to these perspectives while using them as an educational resource.

### 4.2 Knowledge of Various Teaching Methods

Environmental educators are familiar with and can employ a range of instructional methods.

For example:

- Select among relevant environmental topics and issues for study based on learners' interests and their ability to construct knowledge to gain conceptual understanding.
- Use a variety of teaching methods and strategies appropriate for the environmental education content and context, such as: hands-on, discovery, inquiry, cooperative learning, community-based, problem solving, service learning, simulations, models, role playing, case studies, interpretation, problem-based and place based learning.
- Select instructional methodologies based on learning objectives, learner characteristics, time requirements, involvement of community members, community dynamics and policies, available resources, and the instructional setting.



### **4.3 A Climate for Learning About and Exploring the Environment**

Environmental educators create a climate in which learners are intellectually stimulated and motivated to learn about their environment.

For example:

- Employ instructional practices to encourage self-directed lifelong learning.
- Encourage mindful and independent thinking and expression of thought to help meet environmental education's goal of developing environmentally literate individuals.
- Recognize and incorporate learners' prior knowledge and experience.
- Excite and engage the audience.
- Provide experiences that increase learners' awareness of and appreciation for the natural, as well as human-designed, environment.
- Incorporate opportunities for learners to have first-hand experiences exploring the world around them.
- Use instructional techniques that encourage learners to ask questions, work cooperatively, and explore a variety of answers.

### **4.4 An Inclusive and Collaborative Learning Environment**

Environmental educators foster openness and collaboration among participants and create an inclusive learning environment.

For example:

- Encourage flexibility, creativity and openness by recognizing that learners' conclusions and decisions are influenced by different assumptions and interpretations about the environment, particularly on environmental issues.
- Relate learners' capacity for collaborative work to their ability to function as responsible and effective individuals.
- Model responsible, respectful, and reasoned behavior during instruction.

### **4.5 Settings for Instruction**

Environmental educators understand the importance of and ensure a safe and conducive learning environment both indoors and outside.

For example:

- Understand that teaching outside requires different safety measures and group/class management skills and strategies than teaching in a classroom.
- Identify, create, and use diverse settings for environmental education appropriate to various subject matters and resources, while promoting positive stewardship for the locations being used for instruction and the learner's sense of place. These may include: school yards, laboratories, field settings, community settings, museums, zoos, and demonstration sites.
- Identify, develop or implement responses to real or perceived barriers to using expanded settings (such as outdoor settings) in an educational and safe manner.
- Link content to learners' local surroundings and experience, then expand learners' application of the instruction, as appropriate, to larger environmental issues and contexts.

## New York

Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent ones thinking.

1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.

1.1b Learning about the historical development of scientific concepts or about individuals who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

1.1c Science provides knowledge, but values are also essential to making effective and ethical decisions about the application of scientific knowledge.

Hone ideas through reasoning, library research, and discussion with others, including experts.

1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.

1.2b Inquiry involves making judgments about the reliability of the source and relevance of information. Work toward reconciling competing explanations; clarify points of agreement and disagreement.

1.3a Scientific explanations are accepted when they are consistent with experimental and observational evidence and when they lead to accurate predictions.

1.3b All scientific explanations are tentative and subject to change or improvement.

Each new bit of evidence can create more questions than it answers. This leads to increasingly better understanding of how things work in the living world.

Coordinate explanations at different levels of scale, points of focus, and degrees of complexity and specificity, and recognize the need for such alternative representations of the natural world.

1.4a Well-accepted theories are ones that are supported by different kinds of scientific investigations often involving the contributions of individuals from different disciplines.

2. Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Devise ways of making observations to test proposed explanations.

Refine research ideas through library investigations, including electronic information retrieval and reviews of the literature, and through peer feedback obtained from review and discussion.

2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.

Develop and present proposals including formal hypotheses to test explanations; i.e., predict what should be observed under specific conditions if the explanation is true.

2.3a Hypotheses are predictions based upon both research and observation.

2.3b Hypotheses are widely used in science for determining what data to collect and as a guide for interpreting the data.

2.3c Development of a research plan for testing a hypothesis requires planning to avoid bias (e.g., repeated trials, large sample size, and objective data-collection techniques). Carry out a research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary.

3. The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena. Use various methods of representing and organizing observations (e.g., diagrams, tables, charts, graphs, equations, matrices) and insightfully interpret the organized data.

3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

Apply statistical analysis techniques when appropriate to test if chance alone explains the results.

Assess correspondence between the predicted result contained in the hypothesis and actual result, and reach a conclusion as to whether the explanation on which the prediction was based is supported.

Based on the results of the test and through public discussion, revise the explanation and contemplate additional research.

3.4a Hypotheses are valuable, even if they turn out not to be true, because they may lead to further investigation.

3.4b Claims should be questioned if the data are based on samples that are very small, biased, or inadequately controlled or if the conclusions are based on the faulty, incomplete, or misleading use of numbers.

3.4c Claims should be questioned if fact and opinion are intermingled, if adequate evidence is not cited, or if the conclusions do not follow logically from the evidence given.

Develop a written report for public scrutiny that describes the proposed explanation, including a literature review, the research carried out, its result, and suggestions for further research.

3.5a One assumption of science is that other individuals could arrive at the same explanation if they had access to similar evidence. Scientists make the results of their investigations public; they should describe the investigations in ways that enable others to repeat the investigations.

3.5b Scientists use peer review to evaluate the results of scientific investigations and the explanations proposed by other scientists. They analyze the experimental procedures, examine the evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations for the same observations.

Explain how diversity of populations within ecosystems relates to the stability of ecosystems.

1.1a Populations can be categorized by the function they serve. Food webs identify the relationships among producers, consumers, and decomposers carrying out either autotrophic or heterotrophic nutrition.

1.1b An ecosystem is shaped by the nonliving environment as well as its interacting species. The world contains a wide diversity of physical conditions, which creates a variety of environments.

1.1c In all environments, organisms compete for vital resources. The linked and changing interactions of populations and the environment compose the total ecosystem.

1.1d The interdependence of organisms in an established ecosystem often results in approximate stability over hundreds and thousands of years. For example, as one population increases, it is held in check by one or more environmental factors or another species.

1.1e Ecosystems, like many other complex systems, tend to show cyclic changes around a state of approximate equilibrium.

1.1f Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.

Major Understandings

5.1a The energy for life comes primarily from the Sun. Photosynthesis provides a vital connection between the Sun and the energy needs of living systems.

5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis.

The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment.

5.1c In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes.

5.1d In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.

Plants and animals depend on each other and their physical environment.

The fundamental concept of ecology is that living organisms interact with and are dependent on their environment and each other. These interactions result in a flow of energy and a cycling of materials that are essential for life.

Competition can occur between members of different species for an ecological niche. Competition can also occur within species. Competition may be for abiotic resources, such as space, water, air, and shelter, and for biotic resources such as food and mates. Students should be familiar with the concept of food chains and webs.

Explain factors that limit growth of individuals and populations.

6.1a Energy flows through ecosystems in one direction, typically from the Sun, through photosynthetic organisms including green plants and algae, to herbivores to carnivores and decomposers.

6.1b The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere. For example, carbon dioxide and water molecules used in photosynthesis to form energy-rich organic compounds are returned to the environment when the energy in these compounds is eventually released by cells. Continual input of energy from sunlight keeps the process going. This concept may be illustrated with an energy pyramid.

6.1c The chemical elements, such as carbon, hydrogen, nitrogen, and oxygen, that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment as heat.

6.1d The number of organisms any habitat can support (carrying capacity) is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.

6.1e In any particular environment, the growth and survival of organisms depend on the physical conditions including light intensity, temperature range, mineral availability, soil/rock type, and relative acidity (pH).

6.1f Living organisms have the capacity to produce populations of unlimited size, but environments and resources are finite. This has profound effects on the interactions among organisms.

6.1g Relationships between organisms may be negative, neutral, or positive. Some organisms may interact with one another in several ways. They may be in a producer/consumer, predator/prey, or parasite/host relationship; or one organism may cause disease in, scavenge, or decompose another.

Explain the importance of preserving diversity of species and habitats.

6.2a As a result of evolutionary processes, there is a diversity of organisms and roles in ecosystems. This diversity of species increases the chance that at least some will survive in the face of large environmental changes. Biodiversity increases the stability of the ecosystem.

6.2b Biodiversity also ensures the availability of a rich variety of genetic material that may lead to future agricultural or medical discoveries with significant value to humankind. As diversity is lost, potential sources of these materials may be lost with it. Explain how the living and nonliving environments change over time and respond to disturbances.

6.3a The interrelationships and interdependencies of organisms affect the development of stable ecosystems.

6.3b Through ecological succession, all ecosystems progress through a sequence of changes during which one ecological community modifies the environment, making it more suitable for another community. These long-term gradual changes result in the community reaching a point of stability that can last for hundreds or thousands of years.

6.3c A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of longterm stability.

Human decisions and activities have had a profound impact on the physical and living environment.

Population growth has placed new strains on the environment, massive pollution of air and water, deforestation and extinction of species, global warming, and alteration of the ozone shield. Some individuals believe that there will be a technological fix for such problems. Others, concerned with the accelerating pace of change and the ecological concept of finite resources, are far less optimistic. What is certain, however, is that resolving these issues will require increasing global awareness, cooperation, and action. Since the students of today will be the elected officials and informed public of tomorrow, the teacher should encourage a diversity of activities that will allow students to explore, explain, and apply conceptual understandings and skills necessary to be environmentally literate.

Describe the range of interrelationships of humans with the living and nonliving environment.

7.1a The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources and deplete those resources that cannot be renewed.

7.1b Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental.

7.1c Human beings are part of the Earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected.

Explain the impact of technological development and growth in the human population on the living and nonliving environment.

7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.

7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

7.2c Industrialization brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems.

Explain how individual choices and societal actions can contribute to improving the environment.

7.3a Societies must decide on proposals which involve the introduction of new technologies.

Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.

7.3b The decisions of one generation both provide and limit the range of possibilities open to the next generation.

## **Texas**

(1) Environmental Systems. In Environmental Systems, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: biotic and abiotic factors in habitats, ecosystems and biomes, interrelationships among resources and an environmental system, sources and flow of energy through an environmental system, relationship between carrying capacity and changes in populations and ecosystems, and changes in environments.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be

scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts hands-on laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations, including appropriate first aid responses to accidents that could occur in the field such as insect stings, animal bites, overheating, sprains, and breaks; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) follow or plan and implement investigative procedures, including making observations, asking questions, formulating testable hypotheses, and selecting equipment and technology;

(F) collect data individually or collaboratively, make measurements with precision and accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;



(G) demonstrate the use of course apparatuses, equipment, techniques, and procedures, including meter sticks, rulers, pipettes, graduated cylinders, triple beam balances, timing devices, pH meters or probes, thermometers, calculators, computers, Internet access, turbidity testing devices, hand magnifiers, work and disposable gloves, compasses, first aid kits, binoculars, field guides, water quality test kits or probes, soil test kits or probes, 100-foot appraiser's tapes, tarps, shovels, trowels, screens, buckets, and rock and mineral samples;

(H) use a wide variety of additional course apparatuses, equipment, techniques, materials, and procedures as appropriate such as air quality testing devices, cameras, flow meters, Global Positioning System (GPS) units, Geographic Information System (GIS) software, computer models, densimeters, clinometers, and field journals;

(I) organize, analyze, evaluate, build models, make inferences, and predict trends from data;

(J) perform calculations using dimensional analysis, significant digits, and scientific notation; and

(K) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) evaluate the impact of research on scientific thought, society, and the environment;

(E) describe the connection between environmental science and future careers;

(F) research and describe the history of environmental science and contributions of scientists.

(4) Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to:

(A) identify native plants and animals using a dichotomous key;

(B) assess the role of native plants and animals within a local ecosystem and compare them to plants and animals in ecosystems within four other biomes;

(C) diagram abiotic cycles, including the rock, hydrologic, carbon, and nitrogen cycles;

(D) make observations and compile data about fluctuations in abiotic cycles and evaluate the effects of abiotic factors on local ecosystems and local biomes;

(E) measure the concentration of solute, solvent, and solubility of dissolved substances such as dissolved oxygen, chlorides, and nitrates and describe their impact on an ecosystem;

(F) predict how the introduction or removal of an invasive species may alter the food chain and affect existing populations in an ecosystem;

(G) predict how species extinction may alter the food chain and affect existing populations in an ecosystem; and

(H) research and explain the causes of species diversity and predict changes that may occur in an ecosystem if species and genetic diversity is increased or reduced.

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(A) summarize methods of land use and management and describe its effects on land fertility;

(B) identify source, use, quality, management, and conservation of water;

(C) document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability;

(D) identify renewable and non-renewable resources that must come from outside an ecosystem such as food, water, lumber, and energy;

(E) analyze and evaluate the economic significance and interdependence of resources within the environmental system; and

(F) evaluate the impact of waste management methods such as reduction, reuse, recycling, and composting on resource availability.

(6) Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:

(A) define and identify the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere and the interactions among them;

(B) describe and compare renewable and non-renewable energy derived from natural and alternative sources such as oil, natural gas, coal, nuclear, solar, geothermal, hydroelectric, and wind;

(C) explain the flow of energy in an ecosystem, including conduction, convection, and radiation;

(D) investigate and explain the effects of energy transformations in terms of the laws of thermodynamics within an ecosystem; and

(E) investigate and identify energy interactions in an ecosystem.

(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:

(A) relate carrying capacity to population dynamics;

(B) calculate birth rates and exponential growth of populations;

(C) analyze and predict the effects of non-renewable resource depletion; and

(D) analyze and make predictions about the impact on populations of geographic locales due to diseases, birth and death rates, urbanization, and natural events such as migration and seasonal changes.

(8) Science concepts. The student knows that environments change naturally. The student is expected to:

(A) analyze and describe the effects on areas impacted by natural events such as tectonic movement, volcanic events, fires, tornadoes, hurricanes, flooding, tsunamis, and population growth;

(B) explain how regional changes in the environment may have a global effect;

(C) examine how natural processes such as succession and feedback loops restore habitats and ecosystems;

(D) describe how temperature inversions impact weather conditions, including El Niño and La Niña oscillations; and

(E) analyze the impact of temperature inversions on global warming, ice cap and glacial melting, and changes in ocean currents and surface temperatures.

(9) Science concepts. The student knows the impact of human activities on the environment. The student is expected to:

(A) identify causes of air, soil, and water pollution, including point and nonpoint sources;

(B) investigate the types of air, soil, and water pollution such as chlorofluorocarbons, carbon dioxide, pH, pesticide runoff, thermal variations, metallic ions, heavy metals, and nuclear waste;

(C) examine the concentrations of air, soil, and water pollutants using appropriate units;

(D) describe the effect of pollution on global warming, glacial and ice cap melting, greenhouse effect, ozone layer, and aquatic viability;

(E) evaluate the effect of human activities, including habitat restoration projects, species preservation efforts, nature conservancy groups, hunting, fishing, ecotourism, all terrain vehicles, and small personal watercraft, on the environment;

(F) evaluate cost-benefit trade-offs of commercial activities such as municipal development, farming, deforestation, over-harvesting, and mining;

(G) analyze how ethical beliefs can be used to influence scientific practices such as methods for increasing food production;

(H) analyze and evaluate different views on the existence of global warming;

(I) discuss the impact of research and technology on social ethics and legal practices in situations such as the design of new buildings, recycling, or emission standards;

(J) research the advantages and disadvantages of "going green" such as organic gardening and farming, natural methods of pest control, hydroponics, xeriscaping, energy-efficient homes and appliances, and hybrid cars;

(K) analyze past and present local, state, and national legislation, including Texas automobile emissions regulations, the National Park Service Act, the Clean Air Act, the Clean Water Act, the Soil and Water Resources Conservation Act, and the Endangered Species Act; and

(L) analyze past and present international treaties and protocols such as the environmental Antarctic Treaty System, Montreal Protocol, and Kyoto Protocol.

## **Wisconsin**

Wisconsin's EE standards

### **QUESTIONING AND ANALYSIS**

Students in Wisconsin will use credible research methods to investigate environmental questions, revise their personal understanding to accommodate new knowledge and perspectives, and be able to communicate this understanding to others.

Developing an understanding of the environment and environmental sustainability depends on students' willingness and ability to ask questions about the world around them, speculate and hypothesize, seek information, and develop answers to their questions. Environmental literacy requires a familiarity with some basic modes of inquiry; a mastery of fundamental skills for gathering, organizing, interpreting, synthesizing, and evaluating information; developing explanations; and communicating these understandings to others.

Identify questions that require skilled investigation to solve current problems cited in literature, media, or observed through personal observations

Suggest possible investigations and describe the results that might emerge from the investigations

Evaluate personal investigations and those of others, critiquing procedures, results, and sources of data and suggest improvements to the investigation

State and interpret their results accurately and consider other explanations for their results

Communicate the results of their investigations to groups concerned with the issue

### *Knowledge of Environmental Processes and Systems*

Students in Wisconsin will demonstrate an understanding of the natural environment and the interrelationships among natural systems.

The foundation of environmental education is a basic understanding of the processes of the interacting systems that comprise the environment. Therefore, it is essential that students have knowledge of the earth as a dynamic, physical, and living system that has been affected over time by various human societies. This knowledge is a necessary prerequisite for problem-solving activities required for individual and community response to environmental issues.

#### Energy and Ecosystem

Evaluate the relationship of matter and energy and the flow of energy in natural, managed, and built systems

Describe the value of ecosystems from a natural and human perspective; e.g., food, shelter, flood control, water purification

Evaluate the stability and sustainability of ecosystems in response to changes in environmental conditions

Analyze the factors that determine the number of organisms that can exist in a given area

Analyze past and current trends in ecosystem\* degradation and species extinction

Predict population response to changes in environmental conditions

Evaluate the importance of biodiversity

Relate the impact of human activities in ecosystems to the natural process of change, citing examples of succession, evolution, and extinction

Evaluate ways in which technology has expanded our ability to alter the environment and its capacity to support humans and other living organisms

#### Natural Resources and Environmental Quality

Identify and evaluate multiple uses of natural resources and how society is influenced by the availability of these resources

Assess how changes in the availability and use of natural resources (especially water and energy sources) will affect society and human activities; such as, transportation, agricultural systems, manufacturing

Evaluate the environmental and societal costs and benefits of allocating resources in various ways and identify management strategies to maintain economic and environmental sustainability

Analyze how different political and governmental systems manage resource development, distribution, consumption, and waste disposal

#### Science and Citizenship: Power, Authority, Governance, and Responsibility

Investigate how technological development has influenced human relationships and understanding of the environment

Describe changes in the rates of human population growth in various societies and the factors associated with those changes related to economic and environmental sustainability

Analyze how natural resource ownership and trade influences relationships in local, national, and global economies

Explain the concept of exported/imported pollution; e.g., smokestacks, watersheds, and weather systems

Analyze cause and effect relationships of pollutants and other environmental changes on human health

Illustrate how environmental quality affects the economic well-being of a community

Debate the risks of producing pollutants

Research the roles of various careers related to natural resource management and other environmental fields

Research individuals who have made important contributions to the field of resource management

#### ENVIRONMENTAL ISSUE INVESTIGATION SKILLS

Students in Wisconsin will be able to identify, investigate, and evaluate environmental problems and issues.

Solving environmental problems and issues requires skills in environmental investigations. These skills, in turn, provide students with opportunities to apply and improve their capacity for systems thinking and their understanding of a sustainable world and society. Focusing on environmental issues offers students a means of integrating their knowledge of human and environmental systems and a way of finding personal relevance in that knowledge.

Compare the effects of natural and human-caused activities that either contribute to or challenge an ecologically and economically sustainable environment

Explain the factors that contribute to the development of individual and societal values

Maintain a historical perspective when researching environmental issues; include past, present, and future considerations

Identify the strengths and weaknesses of different approaches to investigating an environmental issue and identify some of the assumptions for each approach

#### DECISION AND ACTION SKILLS

Students in Wisconsin will use findings from environmental issue investigations to develop decision-making skills, and to gain experience in citizen action skills.

Students need decision-making and action skills to contribute toward environmental sustainability. In addition, these skills enable them to analyze the effectiveness of individual versus group action, develop issue-resolution plans that incorporate one or more citizen participation skills, and consider these plans in terms of social, cultural, and ecological consequences and implications.

Identify a variety of approaches to environmental issues, evaluate the consequences of each, and select and defend a position

Evaluate reasons for participation or nonparticipation in an environmental activity in the home, school, or community

Describe the range of political and legal options available to resolve an environmental problem; state for each the costs, benefits, and limitations of effectiveness in practice; and select and defend the best option

Describe the rights and responsibilities of citizenship in regard to environmental problems and issues

Develop a plan to maintain or improve some part of the local or regional environment, and enlist support for the implementation of that plan

Identify and analyze examples of the impact beliefs and values have on environmental decisions

Analyze political, educational, economic, and governmental influences on environmental issues, and identify the role of citizens in policy formation

Use cost-benefit analysis to evaluate proposals to improve environmental quality

Describe the regulatory and economic approaches to improving the environment and explain the advantages and disadvantages of each

#### PERSONAL AND CIVIC RESPONSIBILITY

Students in Wisconsin will develop an understanding and commitment to environmental stewardship.

Environmentally literate students recognize how their individual behaviors affect the environment. They have the knowledge, skills, and confidence to act on their own about what should be done to maintain an economically and ecologically sustainable environment. They will recognize that their participation in activities can lead to resolution of environmental challenges.

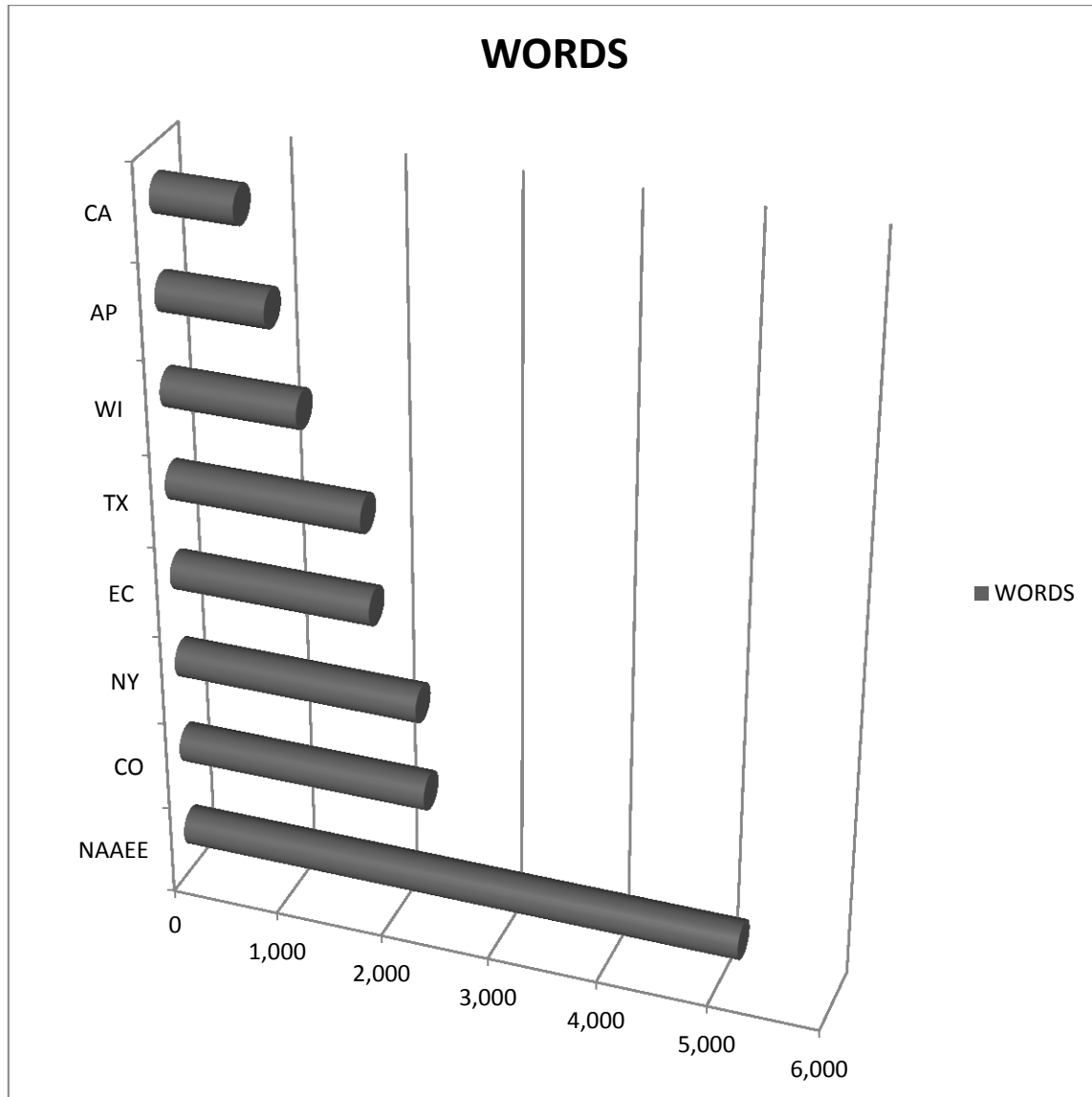
Articulate their personal beliefs regarding their relationship to the environment

Write a plan of action based on personal goals of stewardship for an economically and ecologically sustainable environment

Take action in regard to environmental issues in the home, school, or communities



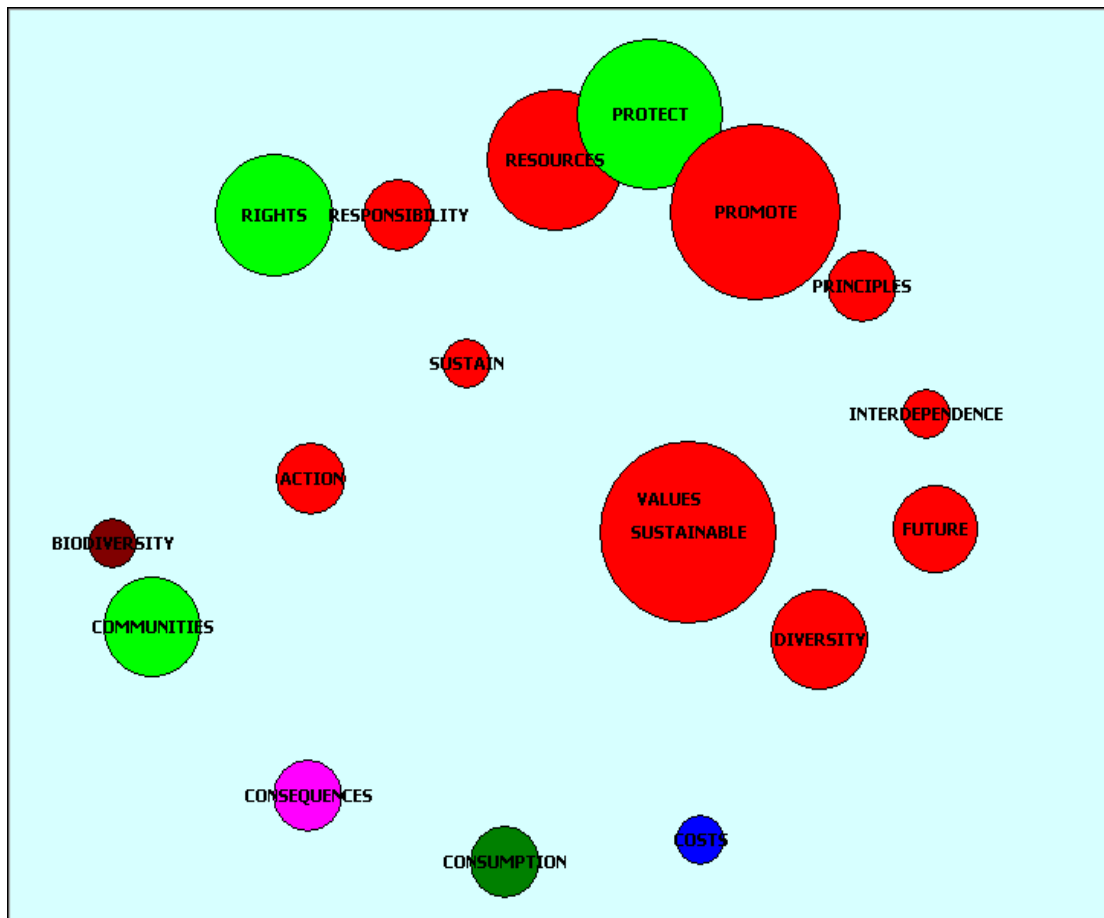
**APPENDIX D**  
**WORD COUNT OF EACH DOCUMENT**



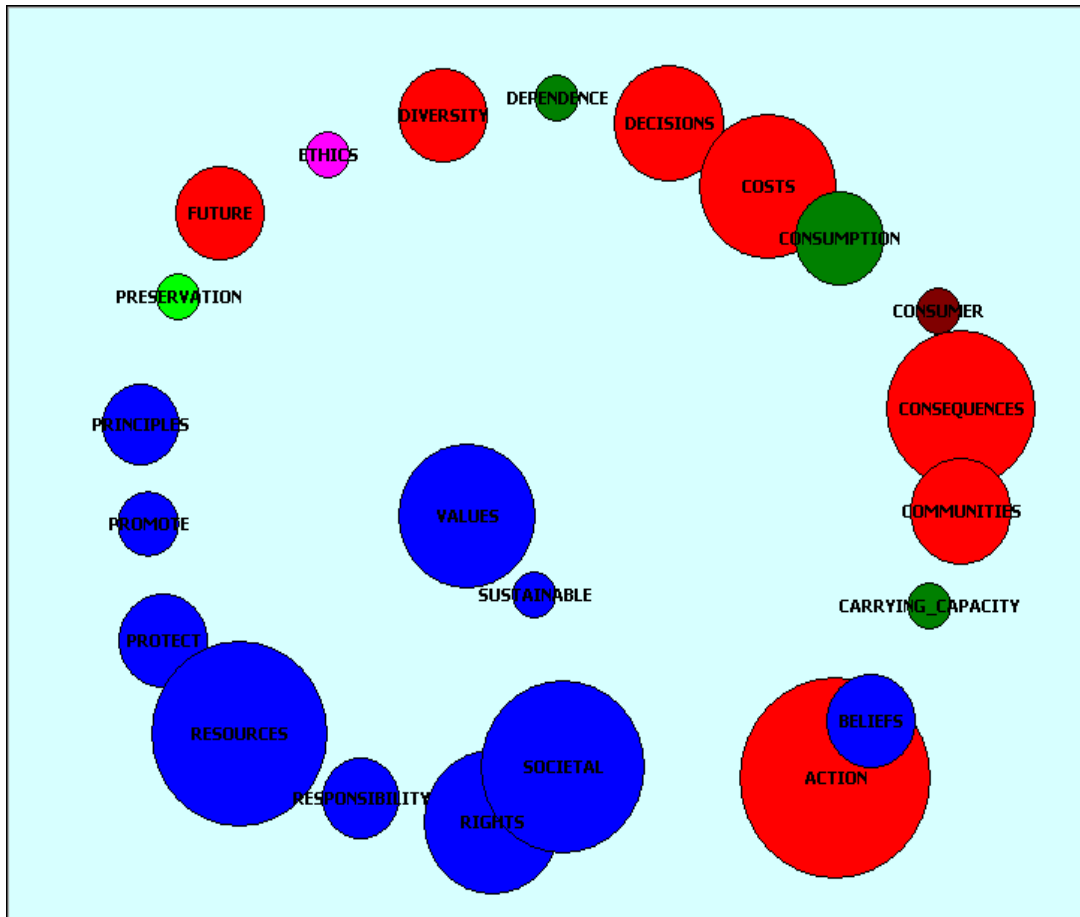
## APPENDIX E

### BUBBLE PLOTS WITH ECO-VALUES DICTIONARY

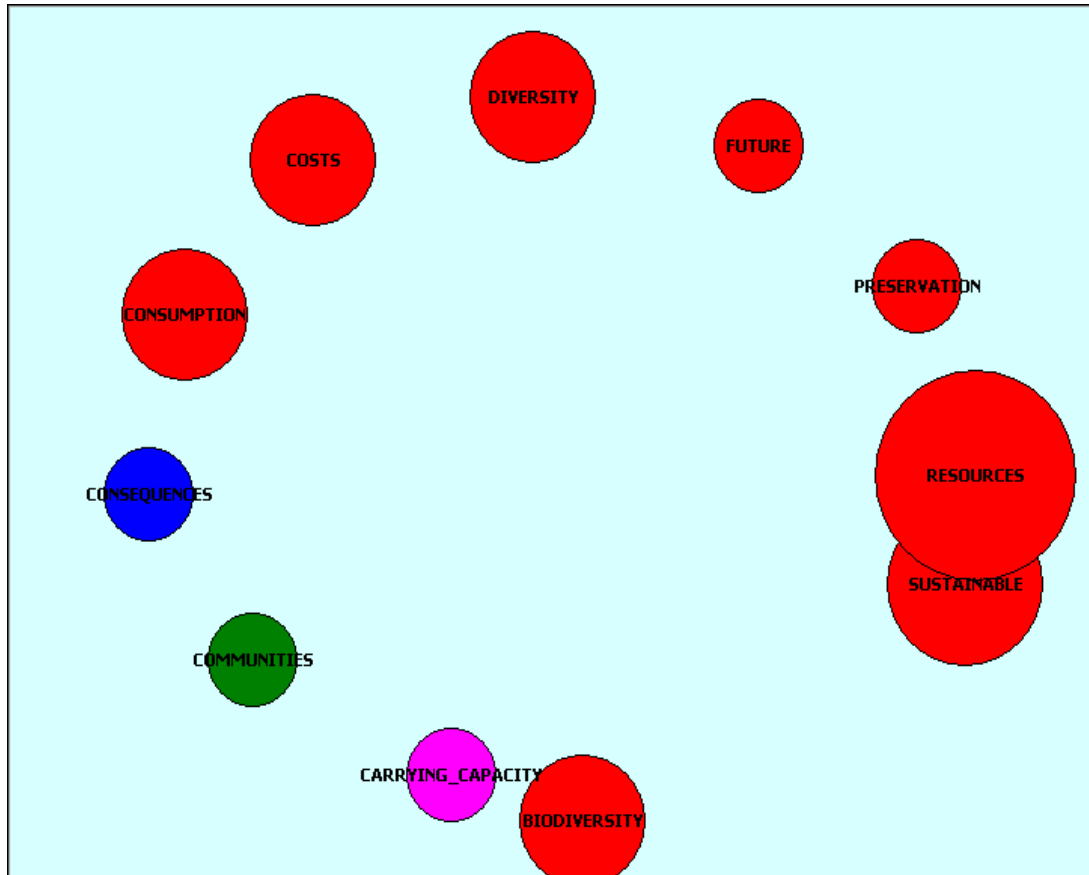
Earth Charter: All the words in the red bubbles tend to group together in the document. Values and sustainability overlap. Although the words protect, rights and communities are grouped together in the document, protect is also found near promote and resources. Rights is also found near the term responsibility. The remaining terms are used less frequently in the document and do not group with the other terms of the eco-values dictionary.



NAAEE: The terms ethics, preservation or consumer do not group with any of the other terms in the document. The terms in blue group together in the document and the term beliefs also is found near the term action. The terms dependence, consumption and carrying capacity group together in the text and consumption is also near the term costs in the text.



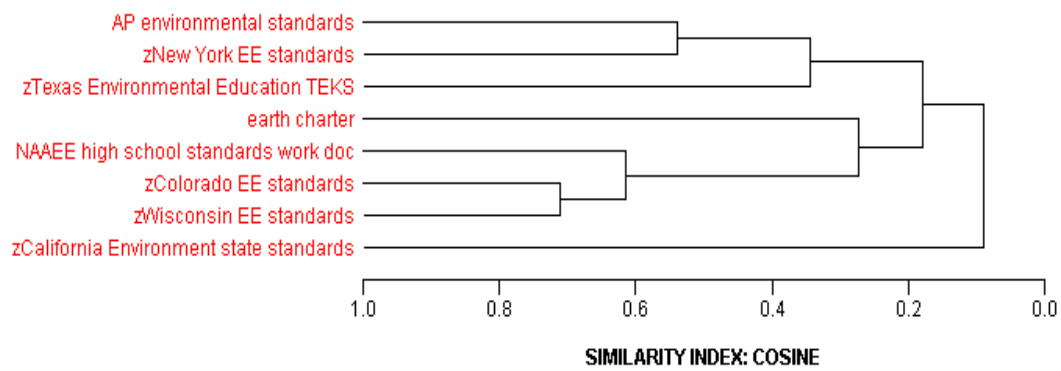
AP: The AP contained fewer terms from the eco-values dictionary. The terms resources and sustainable overlap in the text. This bubble plot was forced into four clusters to detect differentiation.



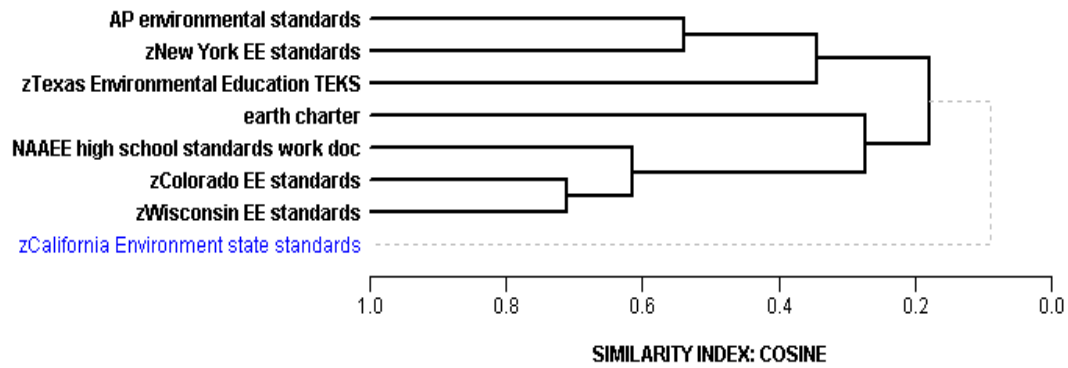
**APPENDIX F****DIVISIVE CLUSTERING OF ALL DOCUMENTS**

Eco-values Dictionary

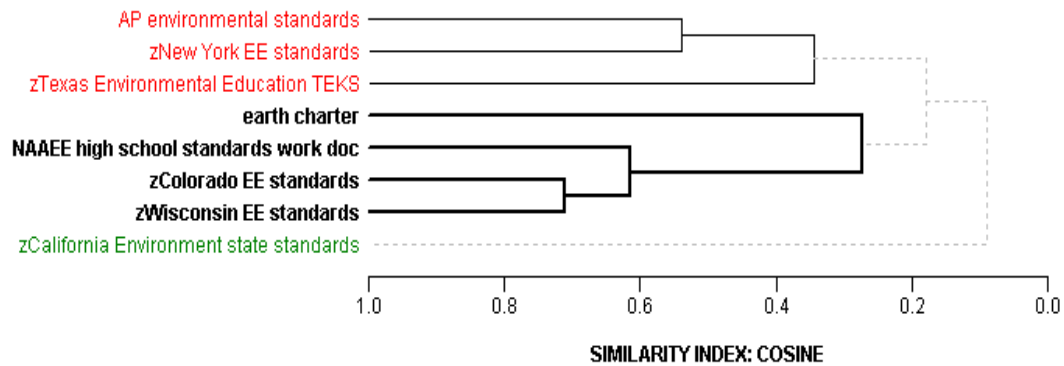
All texts are grouped into one cluster.



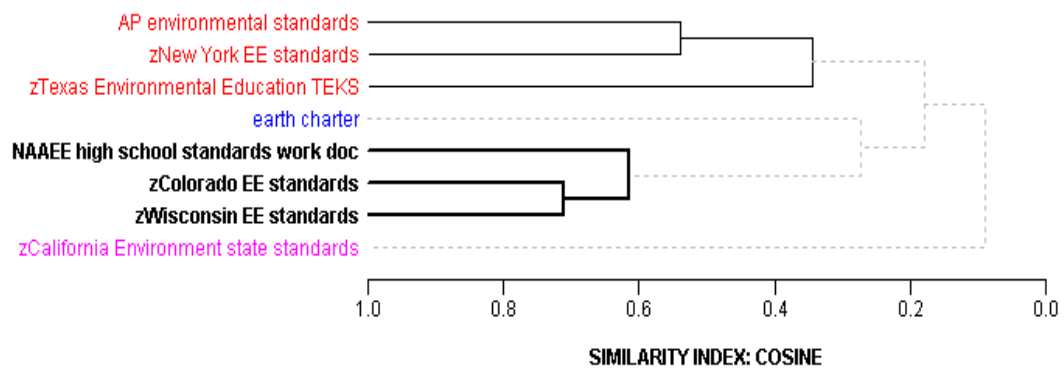
When forced into two clusters, the California standards form a separate group from the rest of the texts.



When forced into three clusters, the AP, NY and TX standards from one grouping, the Earth Charter, NAAEE, CO and WI form another grouping and the CA standards a third group.

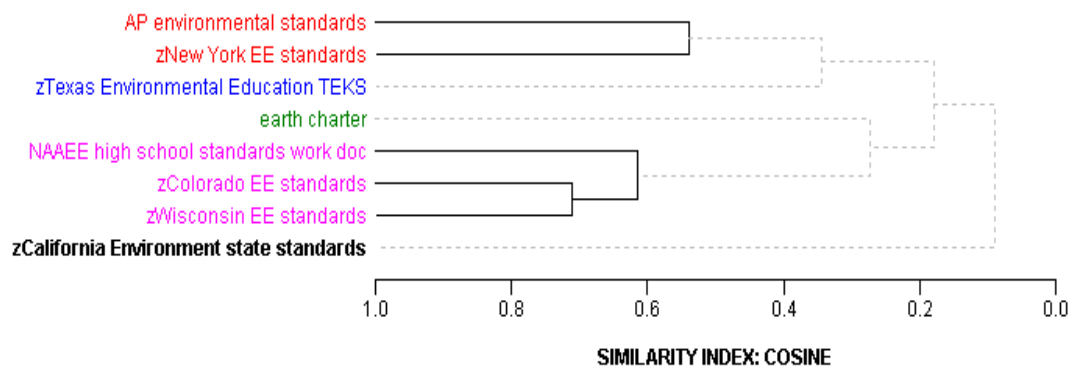


When forced into four clusters, the EC forms a fourth group.

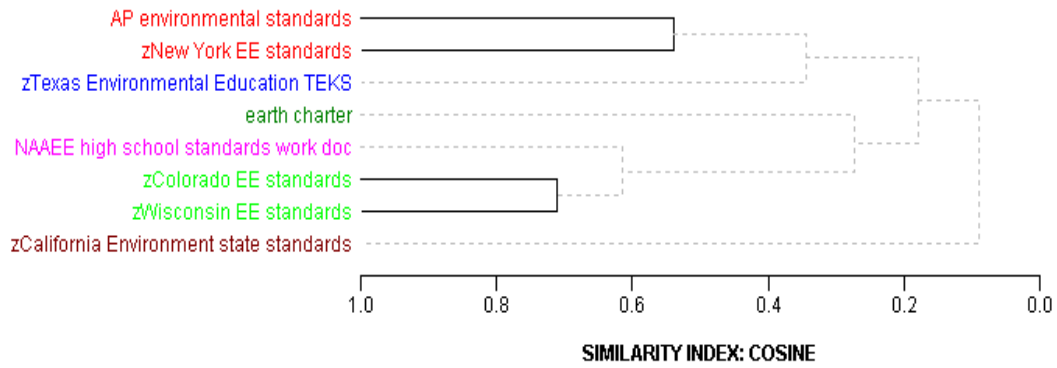




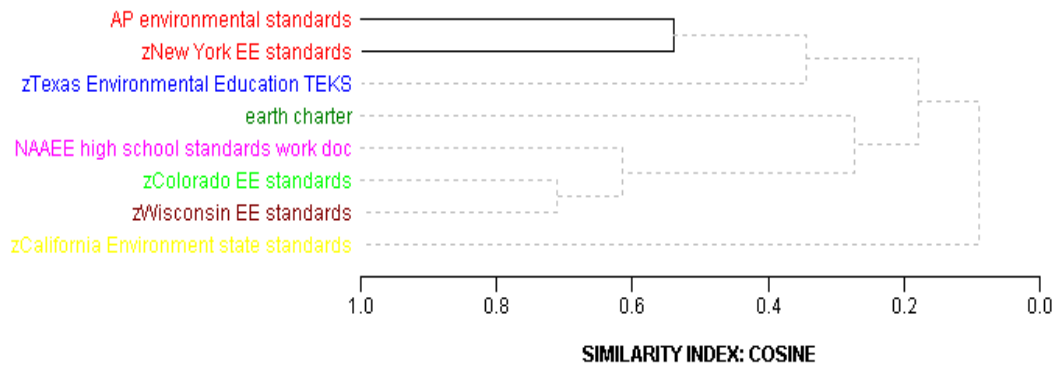
When forced into five clusters, the TX standards form a fifth group.



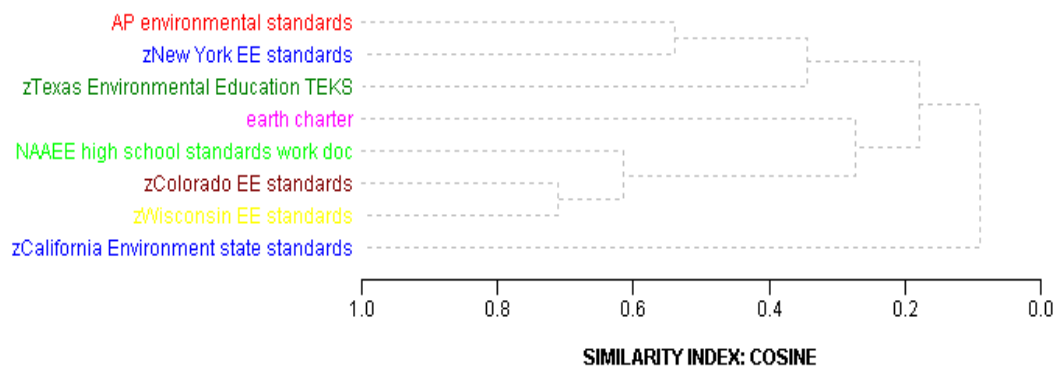
When forced into six clusters, the AP and NY standards form one group, the CO and WI standards form another group, the TX another, the EC another group and the CA another group.



When forced into seven clusters, the CO and WI finally break into two groups, but the AP and NY remain together in one group.

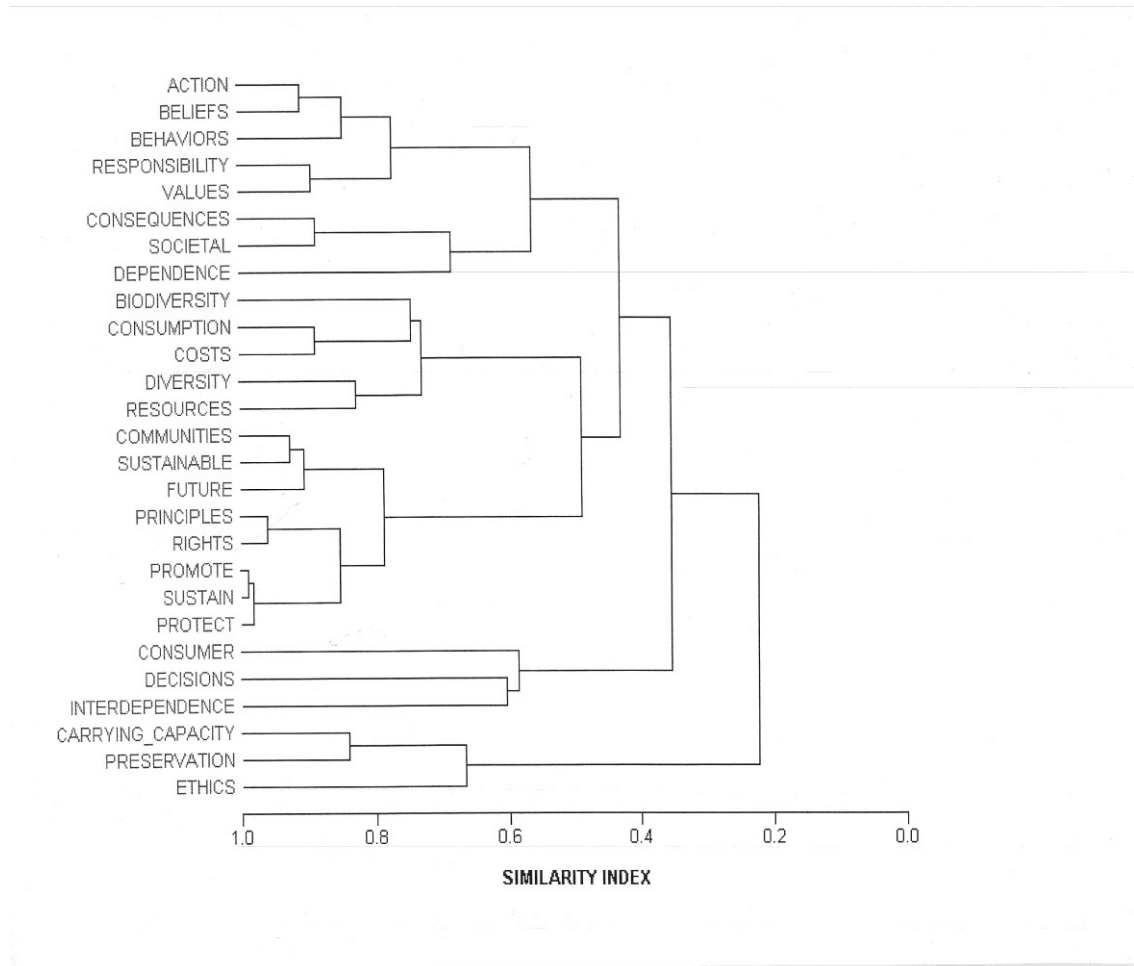


When forced into eight clusters, each document will, of course, be in its own individual group.



## APPENDIX G

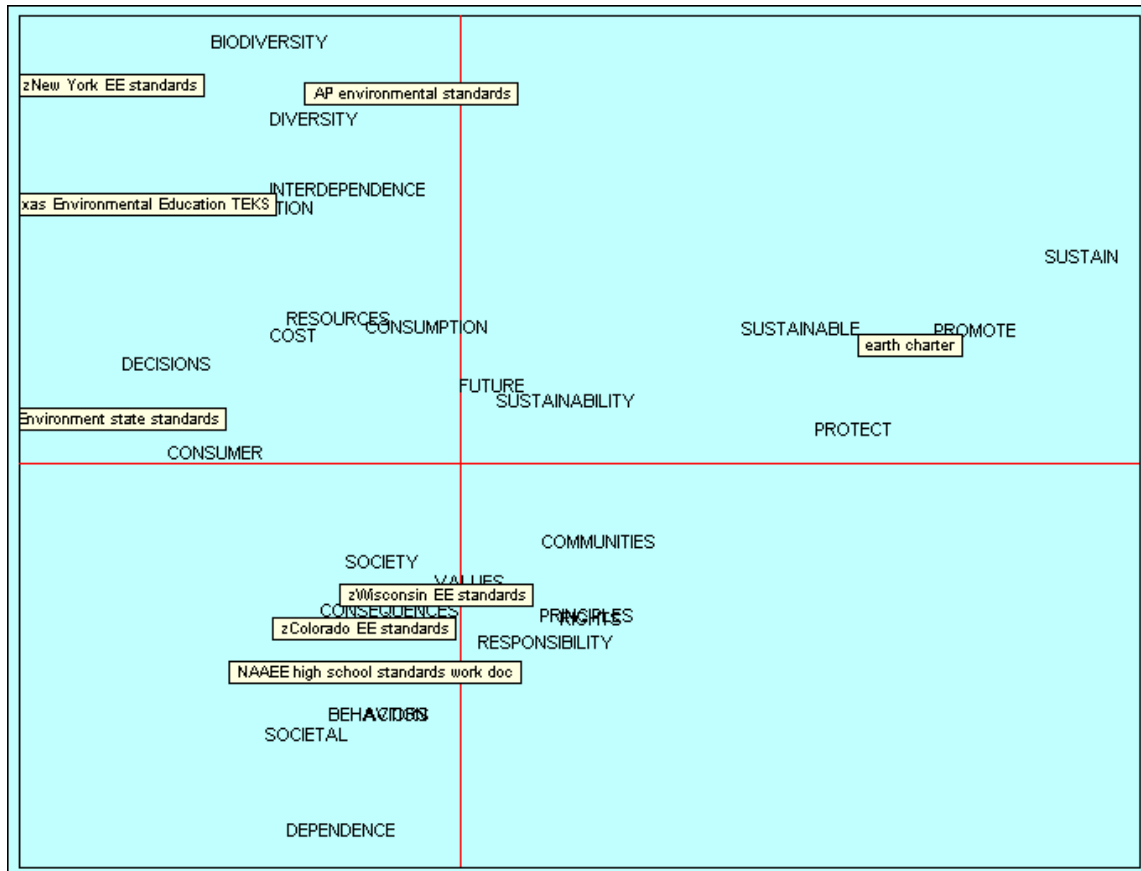
### DENDROGRAM OF INDEPENDENT VARIABLES WITHIN ALL TEXTS



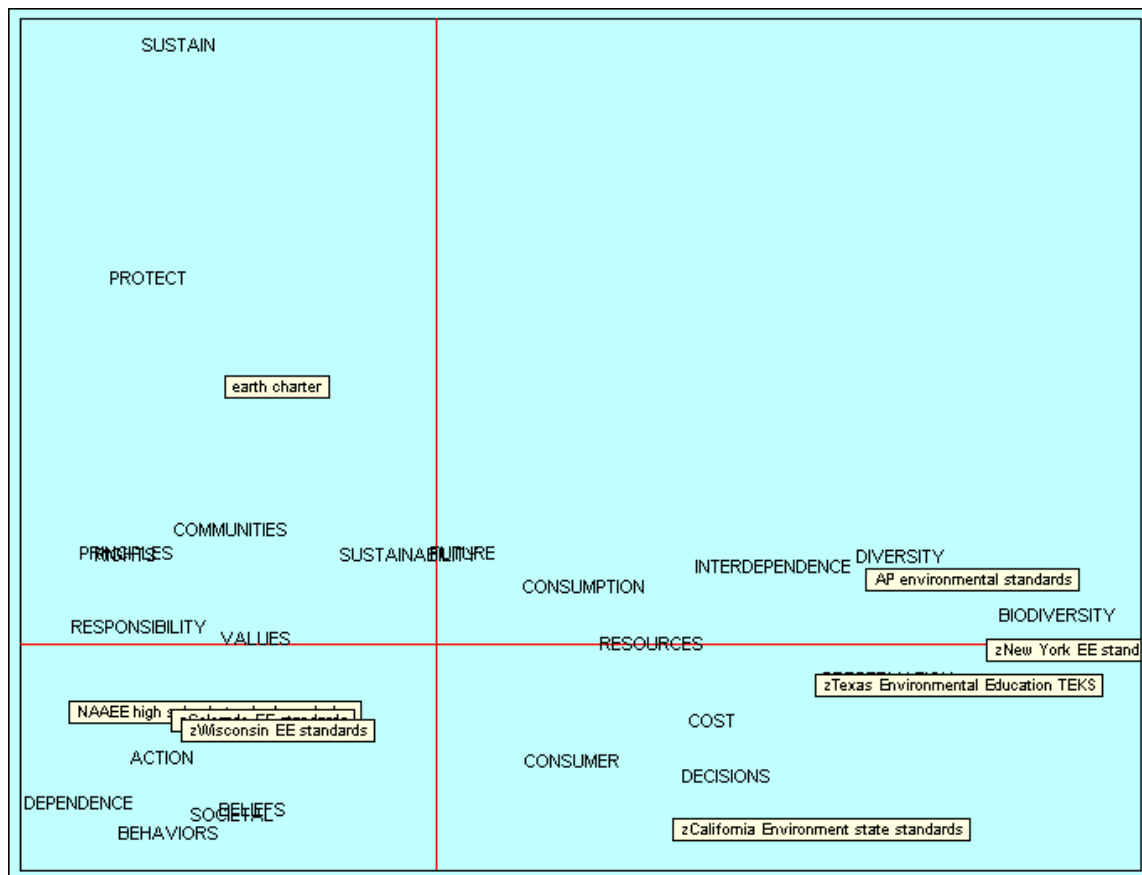
## APPENDIX H

### REMOVAL OF NOMINAL VARIABLES FROM ECO-VALUES DICTIONARY

Term *Values* on Y-Axis



### Term Values on X-Axis after Removal of Variables



## APPENDIX I

### QUALITATIVE CATEGORIES WITH TERMS

**Sustainability eco-values-** value synonyms, acting to protect the environment

Values  
Sustainability  
Ethics  
Morals  
Principles  
Responsibility  
Protect  
Promote  
Preservation  
Future  
Beliefs

**Science education processes-** Science ed pedagogy, nature of science, inquiry, science processes

Evaluate  
Explain  
Describe  
Analyze  
Identify  
Skills  
Evidence  
Include  
Scientific  
Research  
Models, Modeling  
Process  
Methods  
Data  
Investigation

**Ecology Terms-** ecological study of nature, not human interactions with environment

Systems  
Ecosystem  
Cycle  
Energy (sun, food webs)  
Species  
Organism  
Laws  
Carrying capacity  
Processes



**General Education-** Non-science education terms

Education  
 Learners  
 Students  
 Educators  
 Knowledge  
 Understanding  
 Settings  
 Experience

**Economic words-** influences of economic behaviors and political issues on the environment

Economic  
 Cost  
 Consumer  
 Consumption  
 Treaties  
 Development

**Environmental agency-** issue analysis and environmental action

Action  
 Decisions  
 Consequences  
 Rights  
 Issues  
 Behavior  
 Personal

**Life supporting-** human dependence on the environment

Life  
 Human  
 Earth  
 Health  
 Interdependence  
 Dependence  
 Biodiversity  
 Communities  
 Renewable

**Environmental Education** -People in the environment

Environment  
 Pollution  
 Conservation  
 Population  
 Issues

Global  
Local  
Effects  
Energy (production and use)  
Management

## VITA

Julie Annette Singleton

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### Education

Doctor of Philosophy Curriculum and Instruction	Texas A&M	12/11
Master of Education in Kinesiology with Emphasis in Outdoor Education	Texas A&M College Station, TX	12/98
Bachelor of Science Earth Science	Stephen F. Austin State Nacogdoches, TX	5/88

### Certifications

Texas Teacher Certified	Composite Secondary Science Earth Science	Expires 2012 Lifetime
Texas Environmental Educator	TEEAC	Lifetime

### Professional Experience

Intro to Teaching, online course, secondary	Texas A&M, TLAC	1/11-3/11
Professional Development Assistant, Professional Learning Communities-Model for Entry into Science Teaching	NSF grant	1/08-12/10
Senior Science Methods	Texas A&M, TLAC	1/08-12/10
Science Teacher Science Department Chair	Gregory-Lincoln Learning Center Houston ISD	8/02-8/07